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# HERBERTIA

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Journal of the International Bulb Society, Volume 65

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# **HERBERTIA**

Journal of the International Bulb Society

**VOLUME 65**  
**2011**



**International Bulb Society**

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David J. Lehmiller • Editor

**Cover Photo:** *Cyrtanthus obliquus*. Joubertina, Eastern Cape,  
South Africa, November 30, 2008.  
Photo by Cameron McMaster.

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Herbert Kelly Jr.  
President

## EDITOR'S COMMENTS

The circumstances surrounding the Society's awards this year are lamentable. The recipient of the Herbert Medal, Harry Hay, and the recipient of the Traub Award, Leonard Doran, both passed away during the interval between when they received their awards and the publication of their accolades in this issue of *Herbertia*. Both individuals were overjoyed to receive the awards and were very much appreciative of these honors. These two men were outgoing and generous plantmen who brought happiness to many IBS members and other like-minded plant lovers. Sadly they will be missed by all.

Again we have manuscripts and testimonials originating from many parts of the world, attesting to our namesake that we are indeed an international organization. Authors and contributors in this issue reside in Argentina, Australia, Germany, India, Israel, Italy, South Africa, United Kingdom, and United States.

The feature article in this issue has been provided by Philip Adams, a long time IBS member. His contribution represents a lifetime's work in the genus *Lycoris*, and it includes details on many species, commercial hybrids, and never-before-seen hybrids created by the author. The work is richly illustrated with a wealth of photographs. Surely this account will become a collector's reference for many years to come.

IBS members will recognize a number of the remaining authors. Additional articles include new species of *Allium*, *Ornithogalum* and *Tulbaghia*, and a new topotype designation in *Crinum*. There are overviews on *Ammocharis* and *Haemanthus*, again richly adorned with photographs. Two Australian articles focus on native *Crinum*. The issue concludes with articles on *Hippeastrum*, tuberose, and intergeneric hybridizing.

In closing, I would like to express my appreciation to the IBS President, Herbert Kelly Jr., for his assistance in preparing this issue of *Herbertia*. As everyone on the IBS Forum knows, it is Herb's efforts and contributions that are responsible for the continuing success and survival of the Society.

— David J. Lehmiller, Editor

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# THE HERBERT MEDAL



The Herbert Medal is the highest honor that the International Bulb Society can bestow upon a person for meritorious achievement in advancing the knowledge of bulbous plants. The medal is named for William Herbert (1778-1847), son of Henry Herbert, Earl of Carnarvon. William Herbert had a predilection for amaryllids and achieved success in their hybridization. He published his research findings in several monumental works. His contributions as a pioneer geneticist and plant breeder, and his arrangement of the Amaryllidaceae, helped set the stage upon which other workers, both amateur and professional, have been able to advance.

The Herbert Medal may be awarded annually or on special occasions by the Board of Directors of the Society. Candidates for the Medal are recommended to the Board of Directors by the Awards and Recognition Committee. Medalists need not be members of the Society to be considered for the Herbert Medal. The award includes honorary life membership in the Society.

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## 2011 HERBERT MEDALLIST

### HARRY HAY



**Fig. 1.** Figure 1. Harry Hay (left) joined by 2001 Herbert Medallist Graham Duncan (right) for the Awards Ceremony at Harry's home on March 4, 2010. With Professor David Mabberly officiating at the event, 1992 Herbert Medallist Brian Mathew presented the Herbert Medal to Harry. Photo by John Grimshaw.

## HARRY HAY – A BRIEF BIOGRAPHY

By David Victor<sup>1</sup>

E-mail: davidxvictor@btinternet.com

It is more than half a century since Harry started creating his garden on scrubland atop Reigate Hill on the North Downs in south-eastern England. His 7-acre [3ha] garden plot, of heavy clay soil with large flints on chalk, is in a wet and windy exposed site at 740ft above sea level [225m altitude]. For the past 43 years Harry has issued an annual seed exchange list worldwide to 100 botanical institutions and non-commercial private collectors. Cleaning chaff from the seeds, packaging and dispatching

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Footnote <sup>1</sup>: IBS Member David Victor submitted a proposal to the IBS Awards Committee in which he nominated Harry Hay for the Herbert Medal; David also solicited the supporting testimonials which are published at the conclusion of Hay's biography.

them is a labour of love for Harry, as he has never accepted payment from any recipient. Harry has always been motivated primarily for the furtherance of the plant world. Botanical photographers have for many years captured images of his specimens for publication in books (e.g., the series by Roger Phillips and Martyn Rix) and periodicals based in Britain, France and South Africa, amongst others. Over several decades Harry has bought shares in major plant collecting ventures, including the Alpine Garden Society Expedition to China (ACE) in 1994, expeditions by John Watson, and many collections by Compton, d'Arcy, Rix and colleagues. Dissemination of seed by Harry has resulted in several plants becoming available in cultivation.

Harry Browning Hay was born in Watford, some miles north of London, during 1922. Harry's father, J. Gordon Hay, F.R.I.C., an analytical chemist inspired Harry's lifelong interest in the weather and physics generally. Harry married his wife, Yvonne, over fifty years ago and they have two sons, a daughter and five grandchildren aged between 5 and 17 years.

Harry attended Reigate Grammar School but his education was truncated by volunteering for the Second World War effort. After the war, he worked the land, saving-up and borrowing funds before starting his own farm at its present site during the 1950's.

Harry began farming wheat and pigs over half a century ago. However, government compulsory purchase in 1972 took a large part of his farmland for the construction of the M25 London orbital motorway and, later, even more land to build a major intersection. For these land grabs he received only a third of the land's replacement value, and no further adjacent land was available. Thus, the first brought an end to Harry's wheat farming and the second to his pig farming. Financially the family would not have survived had Harry not focused on the necessity of virtual self-sufficiency in vegetable growing, as well as developing acumen in share dealing. To our benefit, he also focussed on the development of his plant collection.

As the years have passed, convenience of the motorway's proximity to London, the port of Dover and the airports at Heathrow and Gatwick, have produced lucrative offers to sell his property, but Harry is devoted to his collection and will not think of moving.

As a result of the nearby road, traffic is nearby at all times, day and night. Airborne oily, sooty deposits from the motorway traffic exacerbate asthma in Harry and both subsequent generations of Hayseeds.

Consequently he has to take strong steroid medication which causes serious side effects.

With foresight, in 1972 Harry added a plantation of poplars and botanical lime tree and other specimens to reduce wind damage, noise and particulate pollution. Lamentably neighbours felled a shelter-belt of healthy mature trees exposing Harry's arboretum to south westerly damage, speeded up by a funnelling effect of the cut-out motorway as winds rise over the 300 ft escarpment. Harry says this results in 40% greater rainfall than 18-mile distant London. He considers it a fascinating - and challenging - microclimate worthy of study by meteorologists.

An indication of how seriously Harry takes his plants and garden is that he last had a holiday more than 46 years ago, in 1963, the year that President Kennedy was assassinated. Over the years, Harry has preferred to spend any spare funds on enhancements to the garden: These have included three large greenhouses, three large polytunnels and designing and building a series of knee-high raised bulb beds on a slope, as well as brick bunkers for leaf mould, sand and compost production. After sterilisation, his potting compost reaps results others fail to achieve in Britain. He says the secret is beech leaf mould and precise watering after germination.

Until his 80s Harry literally worked from dawn till dusk - or beyond - seven days a week, maintaining his garden and collections, mostly without help from anyone. His understanding of weather patterns has been compared with enthusiasm more usually displayed by an avid supporter of a football team. For him it is essential to be attentive, to assess suitable tasks and to protect plants from extremes of temperature, moisture or wind.

Harry dismisses Global Warming, as the world is still coming out of the last ice-age. He predicts the onset of a mini ice-age during the next 100 years across NW Europe in the event of three consecutive wet summers - e.g. 2007 and 2008 (40 inches rainfall each at Harry's garden).

Harry makes an annual donation of specimens to the plant auction raising funds for the Tree Register of the British Isles (a charity of which HRH Prince Charles is patron). On Roy Lancaster's recommendation, a representative visited Harry in 2008 and recorded 12 specimens as current national champions in terms of size, including *Betula ermanii* 'Grayswood' at 15m tall, 137cm girth. Membership of the International Dendrology Society delights Harry enormously and several younger members of the Hay family share his admiration for trees, along with bulbs.

Rats and voles dig up and consume bulbs voraciously at Harry's. Harry has described in his Index Seminum seed exchange lists some highly successful mouse-trapping via a drop of aniseed oil on hazelnut bait. Many pots of bulbs have been completely emptied down to the crocks including collections of *Crocus*, but mousetraps actually baited with *Crocus* corms are always ignored. Aniseed also works for rats if caught first time.

Bulbs grown by Harry include:

- *Pseudogaltonia clavata* (the coconut bulb) from the Kalahari desert - Harry's specimens are illustrated in *Conservatory Plants* (Phillips & Rix 1997) and Graham Duncan mentioned in *Veld & Flora* magazine (Dec. 2008). Harry appears to be the only person in Britain to have flowered it from seed.
- *Rhodophiala bifida* 'Harry Hay' which he crossed and selected from wild-origin seed - the colour (deep blood red) and flower shape and size is constant compared to wild origin plants.
- *Galanthus elwesii* 'Yvonne Hay', named for Harry's wife - a large-flowered snowdrop with weighty bulb.
- *Cyrtanthus falcatus* over 40 years ago he germinated from seed collected by Prof. George Delpierre which appears hardy in Britain as Harry grows it in an unheated polytunnel.
- *Merwillia plumbea* (syn. *Scilla natalensis*), a gift from Chris Brickell 40 years ago.
- *Tulbaghia cominsii* 'Harry Hay's Pink' - after he finished working on his *Tulbaghia* monograph, Canio Vosa gave his research collection to Harry.
- *Pamianthe* sp. - an undescribed species.
- *Resnova* sp. - a bulb that circulates under the unpublished name of *R. megaphylla*.
- *Lycoris radiata* grown from seed obtained from Shanghai Botanic Garden.
- *Oxalis virgosa*, the South American rarity.
- *Hypseocharis pimpinellifolius* - from a collection made in Argentina.
- *Cyrtanthus flammosus*.
- *Cyrtanthus brachyscyphus*.
- *Scilla haemorrhoidalis*.
- *Nothoscordum ostenii* - from Uruguay.
- *Hippeastrum argentinum*.

## HARRY HAY'S INDEX SEMINUM

Each year Harry prepares a seed list based on the seed he has hand pollinated in his garden. Here, by way of example, the 2008 list has used as the base of description. In this edition some 244 entries are included.

The front cover is a colour photograph of one of his exceptional flowering plants for the particular year. So, in 2008 it was *Hippeastrum argentinum* CDPR3095 flowering for the first time in cultivation.

The list is also used as a vehicle for conveying information regarding the garden, its plants and even the weather. This particular issue contained interesting information regarding rainfall during the year and how flowering had been affected.

The heart of the list, however, is the seed list itself. The list is arranged with monocotyledon preceding dicotyledon and the families arranged alphabetically within each. The taxonomy is kept up to date by advice from Kew, this time with the help of Prof. David Mabberley.

The list of Amaryllidaceae is particularly strong and exciting. Altogether, 43 species are listed, over half of which are from material that was originally wild-collected. Amongst them there are:

- Habranthus – 4 entries
- Hippeastrum – 10 entries
- Narcissus – 4 entries
- Nerine – 4 entries
- Zephyranthes – 7 entries

In addition to these, there are a number of very rare offerings, including *H. argentinum* (see above), *Eucrosia mirabilis* and *Stenomesson pearcei*.

EDITOR'S NOTE: Harry Hay passed away on June 2, 2010, just a few months after receiving the Herbert Medal; he was 88 years old. He died in his garden, where his ashes were later spread.

## HARRY HAY TESTIMONIALS

**DR. CHRISTOPHER BRICKELL**

**Former Director General of the Royal Horticultural Society**

**Former President of the International Society for Horticultural Science**

I am very pleased indeed to support the proposal that Harry Hay should be nominated for the award of the Herbert Medal from the International Bulb Society.

Harry is one of the most remarkable gardeners I have known during my more than 50 years in horticulture, a quiet, unassuming man with an immense knowledge of plants, particularly the petaloid monocotyledons, which he grows to perfection in his garden near Reigate in Surrey.

While it is not formally recognised as such, his garden eclipses many botanic gardens in the wide and varied range of plants, particularly bulbs, that he grows from wild origin seed, many of which are new to the U.K. Harry is extraordinarily generous in distributing plants from these collections in his garden, as well as through his annual *Index Seminum*, which he sends to his numerous correspondents throughout the world, including many botanic gardens. He has supported many botanical expeditions, particularly those involving young botanists and horticulturists, to many areas of the world and has been instrumental in introducing numerous new plants, including many petaloid monocotyledons, to U.K. horticulture. This has also been important scientifically in providing living material for botanic gardens and other organisations and individuals to use in research projects. A considerable number of plants from his garden, including many new introductions, have also been used to illustrate articles in Curtis's Botanical Magazine, Herbertia and other scientific as well as popular publications.

I first met Harry in the mid-1960's when he came to the Royal Horticultural Society's Garden at Wisley, where I was then the botanist, bearing several trays of plants which he thought we might like for the garden. None of the species he donated was grown at Wisley at that time and, having a particular enthusiasm for bulbous plants myself, I readily accepted them on behalf of the RHS. Subsequently, at irregular intervals, further consignments of plants he had raised were brought to Wisley by Harry which, over a period of years, greatly enhanced our collection of

bulbous plants to use for display as well as taxonomic research.

Visiting Harry's garden is an exciting and somewhat bewildering experience. You are faced not only with large areas of outside plantings full of attractive and interesting plants, many of wild origin, but also with several large greenhouses overflowing with a profusion of Amaryllids, Irids and Liliaceous plants. Some are known, some unknown and still under collectors numbers waiting to be identified. Both outside and under glass it is a treasure house for the bulb enthusiast, none of whom go away empty handed.

His generosity in distributing plants is unparalleled. A personal example of this relates to my interest in the taxonomy of the genus *Colchicum*. I had asked him for seeds of several wild origin *Colchicum* species listed in his *Index Seminum* to grow on for use in my taxonomic work. But, instead of just sending the seeds requested, he dug up and sent corms of all the wild origin species he was growing, so that I did not have to go through the slow process of growing them to flowering size from seed.

Harry has made a very considerable contribution to our knowledge of a wide range of plants, particularly bulbous species in the broadest sense, and would, in my view, be a very worthy recipient of the Herbert Medal

### ALBERTO CASTILLO

**Director of the Ezeiza Botanical Garden in Argentina  
Former Board Member of the International Bulb Society**

Mr. Harry Hay, of Margery Lane, Britain, is one of the foremost present day researchers in the field of geophytes. For several decades at his property he has studied material, often collected in the wild, from bulb experts such as Brian Mathew, Maurice Boussard, Alberto Castillo, Martyn Rix, James Compton, John D'Arcy and many others. They have trusted invaluable living material into Mr. Hay's hands, as they considered him to be more skilled than the staff of even the largest botanic gardens. Those plant collections included undescribed species, unknown forms of described species, and new findings that were both unique and precious given the remote and inaccessible habitats where they were found.

Another field of research in Mr. Hay's hands has been the so-called "Mediterranean House", a novel method of cultivation consisting basically of the cultivation of plants directly in the ground of large greenhouses under controlled drainage conditions.



He has also made countless hardiness tests of plants introduced from all regions of the planet into Britain, and this has produced results of long standing value to horticulture and nursery industry as well.

Every year, Mr. Hay has produces his famous *Index Seminum*, in which he offers to botanic gardens around the world seeds of the species grown and studied in his collection.

In short, for this and other reasons, I warmly second the initiative towards granting Mr. Harry Hay with the Herbert Medal for merit in horticulture.

**DR. JAMIE COMPTON**  
**Botanist, Taxonomist, Field Collector**  
**Former Head Gardener of the Chelsea Physic Garden**

I first met Harry Hay whilst working at Chelsea Physic Garden and was invited by a mutual friend of ours to visit him shortly after that. This would have been in 1984. My first impression of his superb skill at growing bulbs and other perennial plants was to witness the 8 or so brick built raised beds each with a different growing medium in order to accommodate plants from many different wild habitats. These varied from peat, sand, chalky loam, acid sandy gravel, clay, rich woodland humus, limestone brash and many more. Each filled with immaculately labelled bulbs and perennials chosen to suit such soil types. The four glasshouses and three large poly tunnels likewise were filled with plants in each case dominated by bulbs from all over the globe.

Harry has always had a particular fascination for the family Amaryllidaceae and his understanding of the range and cultivation of the genera from this family must be almost unparalleled anywhere in the world. As an example of some of the more difficult members of that family Harry has succeeded in cultivating the blue *Hippeastrum*-like *Worsleya rayneri* and the yellow flowered *Paramongaia weberbaueri*, and from our own collections I have not hesitated in letting Harry try our seed of *Hieronymiella aurea* and *H. clidanthoides* from northwest Argentina and from Turkey *Sternbergia candida*.

In other bulb families Harry has excelled in growing too many species to mention specifically. In fact, I can truthfully say that Harry Hay is the best grower of bulbs that I know. As a result, Martyn Rix, John d'Arcy and

I have donated our seed collections to Harry from the following places: South Africa, China, South Korea, northwest USA, Mexico, Uruguay and Argentina. I have also donated to Harry seed collected from southern Europe, Turkey and Tanzania and hope to continue to do so for as long as Harry is willing to grow them.

**DR. JOHN GRIMSHAW**  
**Botanist, Taxonomist, Author**  
**Gardens Manager at Colesbourne Park**

For much of my life the name Harry Hay has been heard in reverential tones, usually in the context of a good plant that had been received from him, or of some prized specimen known to be in his collection. A series of pictures in books by Martyn Rix and Roger Phillips, captioned ‘at Harry Hay’s,’ only added to the mystique.

I finally got to meet him a few years ago, and on several occasions have had the privilege of being shown round his collection, housed in a series of greenhouses and polytunnels as well as in the open ground. It lived up to expectations, with every inch of space crowded with rarity after rarity, all flourishing in carefully chosen conditions. Needless to say, I also joined the group who could exhibit a choice plant and say proudly, ‘it came from Harry Hay.’

Harry’s influence on bulb cultivation is not to be measured in erudite publications or public displays. It has been the best sort of influence, derived from the art and craft of growing bulbs, maintaining them in cultivation with meticulous records, and distributing them with sage advice to grateful but carefully chosen recipients. In this way he has helped a broad generation of gardeners, improving their collections and horticultural practice alike.

I fully support the nomination of Harry Hay for the Herbert Medal, and believe that his name would a worthy addition to the list of recipients of this prestigious award.

**DR. DAVID MABBERLEY**

**Botanist, Taxonomist, Educator, Author  
Keeper of the Herbarium, Royal Botanic Gardens, Kew**

I think it was in the early 1970s that Harry Hay first wrote to me and we have been friends and corresponded ever since. He is surely one of the most outstanding plantsmen in the United Kingdom, producing his own *Index Seminum* (with which I have had the privilege to help him from time to time).

His arboretum and garden is an oasis and source of information for botanical and horticultural visitors from far afield. His collection of bulbs, patiently assembled from contacts and his supporting plant-hunting exhibitions over many years, never fails to inspire. He is generous with his time and his plants - who has come away without new treasures? Yet he is one of the most self-effacing men I know, wearing his deep knowledge lightly. In fact his understanding of the culture of geophytes from all over the world is prodigious. I can think of no-one more deserving of this honour than he.

**BRIAN MATHEW**

**Botanist, Taxonomist, Author  
1992 Recipient of the Herbert Medal**

A proposal to put forward Harry Hay for the prestigious IBS award of The Herbert Memorial Medal is enthusiastically supported.

I cultivate a fairly wide range of 'bulbs' and often get asked 'can you supply living material of xyz for some research (e.g. cytology, molecular studies, etc.)?' Not infrequently my reply is 'no, but I know a man who can': that person is Harry Hay. Just one example is *Pseudogaltonia clavata*. Years ago, when it was known mainly through just a few herbarium specimens, I mentioned this name to Harry and, before long, a spare bulb duly arrived complete with cultivation instructions.

Harry's gifts are liberal and without conditions, such is his desire to support serious studies of the plants he loves. Equally generously he will share with other plant enthusiasts in the spirit of mutual interest.

Plant explorers often send Harry seeds or plants from their field trips knowing full well that he is the embodiment of an insurance policy, for

he is one who will most likely succeed with their cultivation. Naturally he welcomes the finer details of the habitat to be supplied if possible in order to achieve this success but is also meticulous in checking by whatever means all the available information concerning the requirements of a particular species. Having done that, it is very likely that the subject will be expertly cultivated and maintained and propagated over a long period. An example, although not a rarity, is *Anemone hortensis* which appears on the 2009 seed list: it was originally collected nearly 50 years ago in Greece by one of his many friends, A.W.A. (Bill) Baker. About 12 years ago I was the recipient of an unusual and unidentified Amaryllid from Ecuador [Alan Meerow later identified it as *Eucrosia mirabilis*] so a small bulb was despatched to Harry for safety's sake. In a seemingly impossibly short time a photograph arrived of it in flower, plus some seeds of an experimental cross with another species.

Harry's garden, Margery Hall Pig Farm in Surrey, England, was on one occasion described by me as 'the most famous pig farm in the world', not for its porkers but for botanical reasons, such is his international renown. Maybe it was once famous for its pigs but now it is a botanical treasury. Here, he cultivates an extraordinary range of plants, notably many geophytes but an eclectic assemblage from perennials to trees, shrubs and climbers and from temperate to tropical. This is an unusual, perhaps almost unique, collection much enhanced in value because most of the plants are of recorded origin. A visit to the garden is always revealing and one is very likely to leave with enhanced knowledge as well as some choice plant material.

His generosity in sharing is underlined by the fact that for 43 years he has been sending out an *Index Seminum* of surplus seeds from the garden. The majority of these represent species unobtainable from commercial sources and most come with recorded provenance. These lists are always a delight to receive, carefully arranged by family and nomenclaturally as up-to-date as possible, which nowadays is quite a feat in itself!

Over the course of more than half a century Harry Hay has corresponded and exchanged material with many of the greats of international botany and horticulture. He is one of them.

**DR. MARTYN RIX**  
**Botanist, Field Collector, Author**  
**Editor of Curtis's Botanical Magazine (Bot. Mag.)**

I first heard of Harry Hay through Geoffrey Herklots, when I was working at the Royal Horticultural Society gardens at Wisley, Surrey, in the late 1970s. He was even then a legendary figure, never seen, but providing a stream of interesting rare or new plants for the collections at Wisley. Geoffrey Herklots was making a collection of drawings of Amaryllidaceae, and many rare amaryllids which flowered in Harry's collection were drawn, some of which were later published in 'Growing Bulbs' (Timber Press and Helm 1983).

When I began doing the Pan garden plant series with Roger Phillips in 1980, I visited Harry many times and he was most generous in giving us specimens to photograph. This generosity combined with an insatiable curiosity and appetite for new plants continues today. Apart from growing the plants, Harry has always tried to get seed from the rare ones and send them out in his own *Index Seminum*, for exchange with botanic gardens around the world; an example of this is the white, scented and almost hardy *Hippeastrum argentinum*. For over 20 years Harry had one bulb from Van Tubergen, but no seed; then James Compton brought him a second bulb, and when this eventually flowered, Harry was able to hand-pollinate them and get fertile seed for the first time: (details of this are in his seed list).

Apart from his *Index Seminum*, Harry has distributed thousands of young plants which he has grown from seed and which are surplus to his own needs. Many of them have been the first introductions to cultivation, and have gone on to be successful garden plants. His skill with seed and seedlings is amazing, and we (Compton, d'Arcy & Rix CDR) have given him the first choice of our seed collections to grow and distribute; other seed and bulbs have come from correspondents around the world. One look at the seed list will show the extent of his contacts. He is also a skilled grafter, and is now distributing grafts of his collection of wild-collected *Tilia*.

Harry has also quietly supported expeditions and publications financially, and this has been of great assistance to young horticultural students and gardeners. Add to this his wife, Yvonne's, legendary hospitality

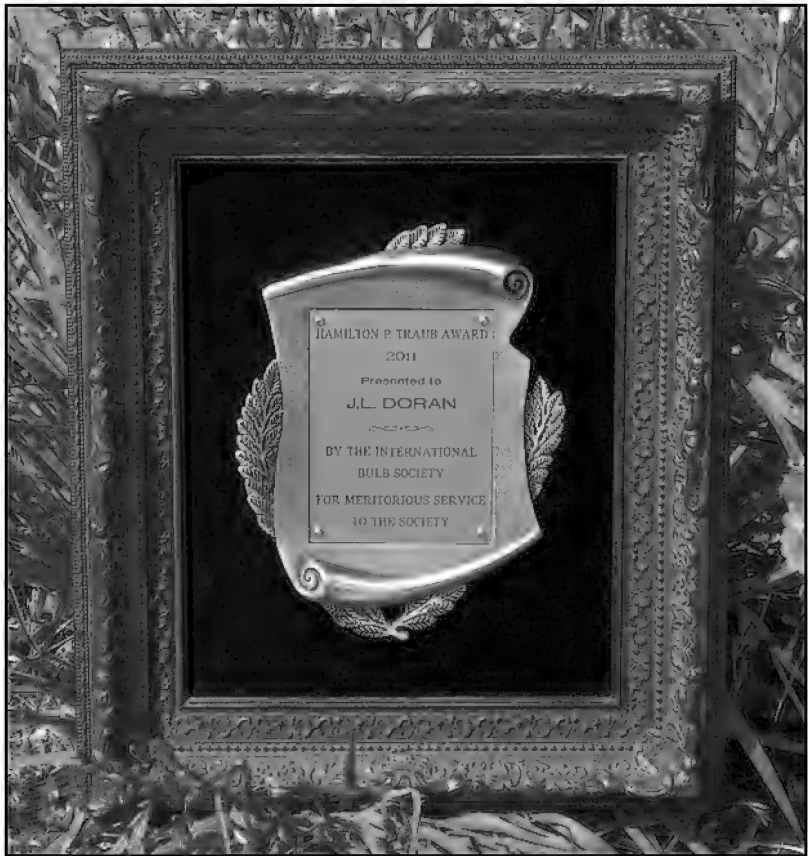
to their friends, and a unique phenomenon is created. No-one can have done more for Plantsmanship in the past 40 years, and the Amaryllidaceae has always been his favourite family.

**THE HAMILTON P. TRAUB AWARD FOR DISTINGUISHED SERVICE**

This award was established in 2000 by the IBS Board of Directors to recognize meritorious service to the Society. It is named after Dr. Hamilton P. Traub, founder of the American Plant Life Society, antecedent of IBS, and editor of its journals for a half century.

**PAST RECIPIENTS**

2000	Mr. Charles E. Hardman	2006	Mrs. Pamela J. Kelly
2001	Mr. Marvin C. Ellenbecker	2007	Mr. Karl E. King
2002	Mr. Michael G. Vassar	2008	Mr. William T. Drysdale
2003	Dr. Alan W. Meerow	2009	Mr. Tony Palmer
2004	Dr. David J. Lehmilller	2010	Mr. Herbert Kelly Jr.
2005	Dr. Charles Gorenstein	2010	Mr. Robert Thompson



2011 TRAUB AWARD  
JOHN LEONARD DORAN



**Fig. 1.** Len Doran holding his Traub Award while standing in front of his residence, March 21, 2009. Photograph taken by IBS President Herbert Kelly Jr. following presentation of the award.



**EDITORIAL NOTE:**

The IBS Awards Committee selected Len Doran for the 2011 Traub Award in 2009, such awards being planned in advance to allow for sufficient time to present the award, to obtain a photograph(s), and to write an autobiography or biography prior to publication. Unfortunately Doran passed away on July 31, 2011, at the age of 96, before he had composed an updated autobiography. Therefore, in recognition of his service and dedication to IBS as well as in honor of his accomplishments, Doran's autobiography from his 1972 Herbert Medal Award is re-published verbatim.

## **JOHN LEONARD DORAN**

### **AN AUTOBIOGRAPHY**

My mother and father were interested in all the marvels of nature and during my childhood I was exposed to these interests. My mother grew many kinds of plants and had a special interest in *Amaryllis*. My interest in *Amaryllis* was aroused early in life but did not reach the "disease point" until about 1960.

My parents sold the Utah farm and moved to California a few days before I was born on December 8, 1914 in San Bernardino, California. My father Junius H. Doran was a civil engineer engaged in the construction of railroads, highways, pipe-lines, etc. My mother Corabelle Whiting Doran was a nurse before her marriage. I grew up in the San Bernardino area.

Although my interest in plants was never submerged for long, I did "stray away" at times. In the late 1920's I built and operated W6BNL, an amateur radio station. I worked on a game bird farm where we raised quail, chuckar, and pheasants. I worked as an analytical chemist for Griffin Laboratories about a year then went to Kincannon Mines as a chemist for a few months. The next job was William Barnhill Laboratories, whose business was soil problems of citrus groves in San Diego, Riverside, and San Bernardino counties. A year later I joined the McKinney Optical Co. who designed and manufactured a diverse line of precision instruments. Here my interests were diverted to applying instrumentation of all types to industrial uses. In 1939 I joined one of the airplane manufacturers in the research laboratory where I was associated in developing the first concepts of the fatigue of material that could be applied to design; a new method,

still used, of measuring' forces developed by high speed wind tunnel models; micro-miniature probes for automatic recording of effects of abnormal environments on animals and humans. After the age of missiles began, I became engaged in development of such things as ultra high speed cameras, underwater firing mechanisms for missiles, squib whistles to induce talking amongst porpoises, high temperature lubricants, and many classified programs. Concurrently we were working on the effects of smog and toxic materials on animals and plants. Because of the need for large quantities of tissue with the same genetic properties in some of the cancer research programs, we developed nutrient solutions and mechanisms suitable for producing great quantities of tissue from a small piece of plant. I became interested in embryo culture of seeds and did development work with medias to complete the growth of incomplete embryos and with auxins and other growth substances to increase the rate of growth and give better development. An important phase of this process is the study of endosperm and embryo contained growth inhibitors and their destruction or removal. In the development of medias, I introduced the Tyndallization process which minimizes the decomposition of organic materials with resulting toxic by-products. A tissue culture process was devised that enabled a small sprig of an outstanding Japanese *Chrysanthemum* given me in December 1956 to be grown to more than 2000 cuttings ready for 1957 spring planting. In 1963, I was able to visit some of the outstanding horticulture establishments in Europe. Carters had an "eye opening" exhibit in the Chelsea show. Michael Hoog of Van Tubergen conducted me through Holland and showed me the methods used by the Dutch to grow and propagate many plants. While in Germany I was guided by Dr. Werkmeister, the geneticist in West Germany's famous University of Geisenheim. I spent several days in the laboratory of K. Stormly Hansen at Hvidovre, Denmark under the tutelage of Dr. Aagard and Mrs. Christensen. The Hansens have led the world in their work of high heat culture and subsequent meristem culture of carnations and by this process nearly freeing the plant of virus diseases. In 1964 I made the first collection trip for amaryllids in the wild; these activities have been recorded in *Plant Life* (Doran, 1969, 1970, 1971).

I wish to thank all the people who have helped with collecting, with identification, and the AMERICAN PLANT LIFE SOCIETY for awarding me the WILLIAM HERBERT MEDAL for 1972.

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Doran, J.L. Notes by an Amateur Collector. *Plant Life* 25:37, 1969.

Doran, J.L. Collecting South American Amaryllids, 1964-1968. *Plant Life* 26:49-56, 1970.

Doran, J.L. Seeds of *Amaryllis reticulata* L 'Hérit. *Plant Life* 27:54, 1971

Then following the autobiography were two current articles by Doran:

Doran, J.L. Exploring for amaryllids in South America, 1969-1970. *Plant Life* 28:8-17, 1972.

Doran, J.L. Corabelle Whiting Doran, a brief biography. *Plant Life* 28:17, 1972.

**EDITOR'S NOTE:** Following his 1972 autobiography and his most recent manuscript on collecting South American amaryllids, Len Doran published a short biography of his mother ... an unusual event. In her biography, Doran related that on some occasions his mother had accompanied him on his South American expeditions, and he particularly highlighted that *Hippeastrum dorianiae* Traub (*Amaryllis dorianiae*) had been named in her honor.



**Fig. 1.** Herbert Medalist – John Leonard Doran. Scan reprint of the photograph accompanying Doran's Herbert Medal Award, *Plant Life* 28:6, 1972.

## NEW SPECIES OF *ALLIUM* SECT. MELANOCROMMYUM FROM THE EASTERN MEDITERRANEAN

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### SUMMARY

Re-study of the molecular relationships in *Allium* sect. *Melanocrommyum* with a broader taxonomic sample confirms the results of Fritsch et al. (2010) and gives additional evidence that *Allium nigrum* L. s. lat. and *A. orientale* Boiss. s. lat. contain several only distantly related taxa. Three morphologically distinct entities occurring in Israel and adjacent territories are described as new species: *A. basalticum* Fragman & R.M. Fritsch formerly included in *A. nigrum*, *A. meronense* Fragman & R.M. Fritsch formerly treated as *A. asclepiadeum* Bornm., and *A. israeliticum* Fragman & R.M. Fritsch formerly subsumed under *A. orientale*. For nomenclatorial reasons, an epitype of *A. orientale* is designated. A distribution map and photographs of the new species are also presented.

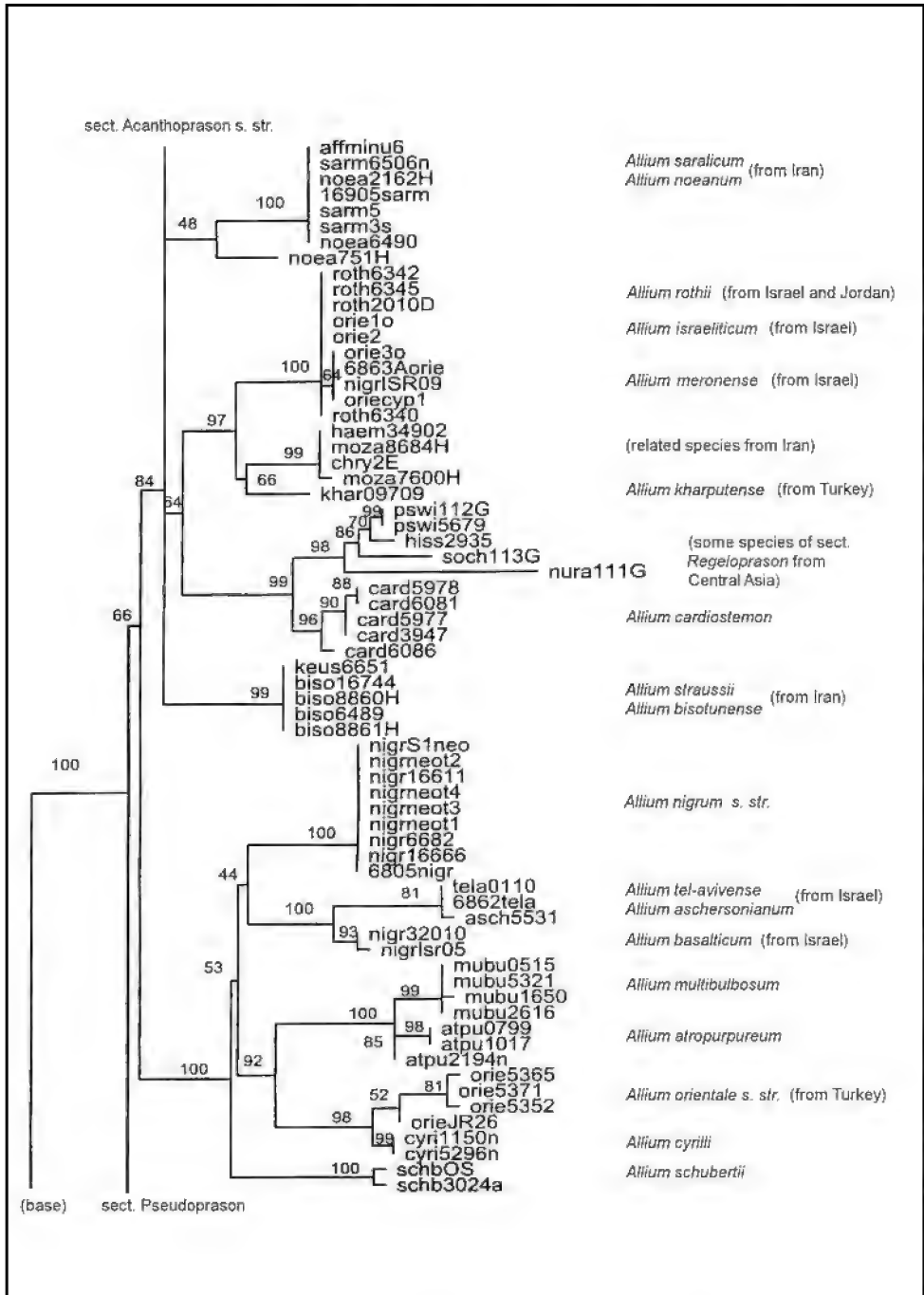
### INTRODUCTION

The botanical exploration of Near East dates back to the earliest phases of modern plant taxonomy. This area was repeatedly visited in the 19th century, and a large number of species were already mentioned in “Flora Orientalis” (Boissier 1882). These activities continued in the first decades of 20th century, more regional floras appeared, and a rather large “basal stock” of plant species became generally accepted as being distributed over the whole geographic area and beyond. In “Flora Palaestina” Kollmann (1986) has reviewed the knowledge on alliums of that time, among them were *A. nigrum* L. and *A. orientale* Boiss.

Kollmann's work was a breakthrough in understanding this exciting genus in Israel and its surroundings. However, recent molecular analyses presented evidence that some polymorphous *Allium* species (among them the above mentioned species) consist of infraspecific groups characterized by different phylogenetic history (Gurushidze et al. 2008, Fritsch et al. 2010). These taxa were monitored in the past years at the Jerusalem Botanical Gardens and distinct new morphological and ecological data supported the molecular ones. Therefore these groups may not constitute one natural species but represent different species. Investigation of additional material resulted in still more convincing and well separated groups often with very good bootstrap support (Gurushidze, unpubl., Fig. 1). Three well recognizable entities from Israel and its surroundings will be described below.

### 1. *ALLIUM NIGRUM* ALLIANCE

*Allium nigrum* L. and *A. multibulbosum* Jacq. were regarded as variants of one variable and widely distributed species over a long time. Only neotypification of *A. nigrum* to Cypriot plants (Seisums 1998, Brummitt 2000) set a clear decision about this taxon in a strict sense. Plants of the type location (Cyprus: 1-2 km NE of Lyso) are characterized by rose oblong tepals, rose filaments, and distinctly tri-sulcate, strongly coarse, dull, permanently green ovaries. Plants of *A. multibulbosum* own white to pinkish-carmine, oblong tepals, filaments of the same color as tepals, but rounded, narrowly hexasulcate, smooth and commonly glossy ovaries most often initially black and later becoming green (but some accessions are having permanently green ovaries). These taxa morphologically circumscribed above belong to well separated molecular groups (Fig. 1). Plants growing in the basalts of the Eastern Galilee and the Golan Heights of Israel are most similar to *A. multibulbosum* but differ by elliptic or obovate, white tepals, purplish suffused filaments, and purplish-black ovaries having six furrows (alternating wide and narrow ones, Figs. 3, 4). Formally they could be separated as infraspecific taxon of *A. multibulbosum*, because the morphological differences to *A. nigrum* s. str. are stronger. The latter owns unicolored, long-elliptic, pink tepals and permanently green, very coarse ovaries. However, the discussed plants from the basalts belong to another molecular clade. They form a distinct molecular group with *A. telavivense* Eig / *A. aschersonianum* Barbey as



**Fig. 1.** RAxML dendrogram with bootstrap data of sect. *Melanocrommyum* (section of an unpublished analysis of Internal Transcribed Spacer (ITS) sequences, for inclusion of some taxa of sect. *Regeloprason* and *A. schubertii* see discussion in Fritsch et al. 2010).

sister, which is sister to *A. nigrum* s. str. and still more distantly positioned from *A. multibulbosum* (Fig. 1).

Another sister of the discussed plants from the basalts is the only investigated accession of *A. dumetorum* Feinbr. & Szel. (Gurushidze unpubl., not shown in Fig. 1), occurring in chalky soil only in Nahal Yagur at the northern Mt. Carmel in Israel. The flowers of this taxon (Fig. 4) are so similar to those of *A. nigrum* that it has been treated as synonym of *A. nigrum* in “Flora Palaestina” (Kollmann, 1986). Nevertheless, our preliminary data support to accept *A. dumetorum* as a separate species, probably a sibling of *A. nigrum* s. str. These remarkable morphological differences among molecular sisters strongly support to recognize also the discussed plants from the basalts of the eastern Galilee and Golan Heights as a separate species newly described here:

***Allium basalticum* Fragman & R.M. Fritsch, sp. nov.**

- *Allium nigrum* auct. Israel., p.p., Fig. 2.

**Holotype: Israel.** Golan Heights, Gamla. 04.1977 leg. Y. Kaplan (HUJ no. 6206)

**Diagnosis:** Differt ab *Allio multibulboso* tepalis albis ellipticis vel obovatis, filamentis purpureo-suffusis et ovariis angulosis alternatim anguste et late hexasulcatis.

**Description:** Bulbs 2-3cm long and 2.5-4cm in diameter, 15-30cm deep, depressed ovate, outer tunics grayish. Scape straight, cylindrical, 25-60cm long, 6-8mm in diameter, smooth, dull green, glaucous bloom. Leaves 3-5, lanceolate, 30-50cm long, (1) 2-5cm wide at about  $\frac{1}{4}$  of length, initially rather stiff upright, later more or less recurved, tapering into a long narrowly-triangular tip, margin smooth; green, with glaucous bloom. Spathe very shortly beaked, splitting into 3-5 deflexed valves, during anthesis valves  $\pm$  stellate, scarious. Inflorescences broadly fasciculate to semi-globose, dense, many-flowered, 6-10cm in diameter; pedicels straight, green, rather thick. Flowers bowl-shaped star-like. Tepals elliptic to obovate, concave, 6-8mm long, 4.5-6mm wide, basally very shortly connate one among another and with filaments, obtuse; white with conspicuous green median vein. Filaments narrowly triangular, somewhat fleshy,  $\frac{1}{2}$  -  $\frac{2}{3}$  as long as tepals, inner filaments 1.5 times wider than outer ones, obliquely forward directed; basally pinkish-carmine fading toward the tip. Anthers oblong with spreading lower end, 1.5-2mm long, pale yellow. Ovaries depressed-globose six-angled (with 3 wide and 3 narrow furrows), 3-4mm



**Fig. 2.** Drawing of *A. basalticum* (Naomi Feinbrun-Dochan, *Flora Palaestina IV*, Plates, Jerusalem; The Israeli Academy of Sciences and Humanities, 1986, plate 131).





**Fig. 3.** Inflorescence of *A. basalticum*, plant cultivated in the Jerusalem Botanical Gardens.



**Fig. 4.** Inflorescence of *A. dumetorum*, plant from the type location – N. Israel, Mt. Carmel, N.Yagur. (photograph by Y. Marta)



**Fig. 5.** Group of *A. basalticum*, plants cultivated in the Jerusalem Botanical Gardens.

long, 4-5mm in diameter, surface smooth, glossy; initially blackish purple, later changing to green. Style narrowly conical, 2-4mm long, pinkish; stigma dot-like, whitish. Capsule three-sided conical, c. 8mm long and in diameter, glossy.

Illustration: Plate 13 C as *A. nigrum*, in: *Allium Crop Science: Recent Advances*, eds. H.D. Rabinovich & L. Currah, CABI Publishing, Wallingford, 2002.

Paratypes: Israel, Lower Galilee, Ramat Sirin, 23.04.1967 leg. U. Eliav (HUJ no. **6164**); Israel, South Golan Heights, near Ramat Magshimim, 09.04.1998, leg. O. Cohen (HUJ no. **98-7507**; Israel, Golan Heights, Upper Wadi Taibe, 24.04.1973, leg. A. Shmida (HUJ); Israel, Golan Heights, Sanbar, 16.04.1969. leg. Maryam (HUJ).

Phenology: The first strong rains occur usually during November. Since the plant's bulb is located rather deep in clayish alluvial soil, it takes several strong rain storms for the water to reach the bulbs and awake them from summer dormancy. As soon as this happens, leaf sprouting takes place and one can see them above ground in December. In February and only then one can see the bud inflorescence above ground. Blooming takes place in mid-March to early April, but occasionally starts earlier in early March and finishes later in late April. Fruits develop and become dry during May, seeds are dispersed in June.

Geographic distribution, habitats and ecology: The species grows primarily in volcanic basalt soils in herbaceous vegetation, mainly among perennial Poaceae and Asteraceae species as well as many other geophytes, such as *Anemone coronaria*, *Asphodeline lutea*, *Narcissus tazetta* and even *Allium schubertii*. These habitats are often inundated in winter, but always completely dry in summer. It grows also in disturbed secondary habitats, primarily in agricultural fields. In such places, especially west of the Jordan Rift Valley, it is not really known what was the primary habitat and whether *A. basalticum* inhabited it in historical time. The largest populations are known from the southern Golan Heights in deep heavy soils; smaller populations are found also in central and eastern Golan Heights as well as west of the Jordan Rift Valley in the Lower Galilee and Jezreel Valley (Fig. 13). In the latter two districts it is almost extinct due to modern agriculture practices (deep plowing and use of pesticides), and is today only known from a handful of sites. The species is also identified in old collections from Lebanon on the Beirut-Damascus road and near the northern Lebanese

border with Syria, in both cases growing in agricultural fields. We assume that the plant occurs sporadically in Lebanon and Syria, since traditionally managed fields are common. Additional surveys are needed to confirm this.  
Chorotype: East Mediterranean.

## 2. *ALLIUM ASCLEPIADEUM* ALLIANCE

Morphologically different plants of the Higher Upper Galilee characterized by pure white tepals and shorter filament bearing basally a distinct purple ring-like zone (Figs. 6, 7) were formerly treated as *A. asclepiadeum* Bornm. and later included in *A. nigrum* (Kollmann, 1986). They are indeed most similar to this and other closely related Turkish species. However, *A. asclepiadeum* differs by undulate leaf laminae, milky-white, soon reflexed, oblong tepals with rounded base, and filaments about half as long as tepals, and differs from the very close *A. nemrutdagense* Kit Tan & Sorger additionally by still longer, uncolored filaments. *Allium karamanoglu* Koyuncu et Kollmann is a more slender plant having narrower (up to 15mm wide) and shorter leaves, a poorer and much denser inflorescence, long acute, basally rounded tepals, completely crème or blackish filaments with black anthers, and a black ovary.

The taxon growing in Upper Galilee is not positioned near Turkish species in the molecular tree (Fig. 1; *A. kharputense* is the closest relative available for molecular analysis) but among taxa growing in Israel, Jordan, and Cyprus. This position as well as its distribution and habitat (Fig. 8) underline its recognition as a new species:

***Allium meronense*** Fragman & R.M. Fritsch, **sp. nov.**

- *Allium nigrum* auctt., *A. asclepiadeum* auctt. non Bornm.

Holotype: **Israel**. Upper Galilee, Mt. Meron. 03.04.1984 leg. N. Bar-Shai (HUJ no. 6160).

Diagnosis: Differt ab *Allio asclepiadeo* staturis validis foliis canaliculatis stricto recurvatis, tepalis rhomboideo-lanceolatis basi triangulari-stipitatis, filamentis tertiis partis vel quadrantis longitudine tepalorum, ovariis nigrescenti-purpureo maculatis et stylis albescentis.

Description: Bulbs 1.5-3cm long and in diameter,  $\pm$  ovate. Scape flexuous or ascendent, 10-20 (- 25)cm long obconical c. 4-5mm in diameter near base, c. 6-7mm below inflorescence, smooth, dull green, purplish flushed near base, with glaucous bloom. Leaves 2-3 (4), triangular-lanceolate,



**Fig. 6.** Inflorescence of *A. meronense* (tepals narrow), N. Israel – Mt. Meron.



**Fig. 7.** Inflorescence of *A. meronense* (tepals ovate), N. Israel – Mt. Meron.



**Fig. 8.** Group of *A. meronense* plants, N. Israel – Mt. Meron.

tapering into a triangular hooded tip, canaliculate, thickish, recurved, 20-30cm long, near base 3-4cm wide, dull green, basally outside and on veins purplish flushed, with glaucous bloom. Spathe shortly beaked, splitting into 3-5 persistent acute valves, finally semi-reflexed, membranous, translucent yellowish-brown with brown veins. Inflorescence initially fasciculate later semi-globose, multiflorous, semi-dense, (3-) 4-6 (-7) cm in diameter; pedicels wire-like thin, ascending, green. Flowers bowl-shaped star-like. Tepals lanceolate to ovate, 7-9mm long, free near base, tapering towards base and the  $\pm$  triangular, obtuse or subacute, often with plicate tip; initially patent, after anthesis  $\pm$  deflexed and crumbled; pure white, median vein narrow, greenish. Filaments triangular,  $\frac{1}{4}$ - $\frac{1}{3}$  ( $\frac{2}{5}$ ) as long as tepals, basally shortly connate, inner filaments 1.5 times wider than outer ones, obliquely forward directed; white, with a distinct purple ring-like zone near the base. Anthers pale yellow, oblong, c. 1.5mm long. Ovary depressed globose-six-angled, 3-4mm in diameter, 2-3mm long, smooth, glossy; green, in anthesis blackish or with many black spots. Style cylindrical, 1-2mm long, whitish, with a dot-like, white stigma. Capsule depressed-globose with six furrows, c. 6mm in diameter, widely opening.

Paratypes: Israel, Upper Galilee, Mt. Meron. 01.05.1967. leg. D. Pery (HUJ no. **6165**); Israel, Upper Galilee, Mt. Meron - near top of the mountain. 02.04.1958. leg. N. Feinbrun (HUJ no. **6170**); Israel, Upper Galilee, Mt. Meron - maquis. 12.04.1965. leg. F. Kollmann (HUJ no. **6171**).

Illustrations: Illustrated flora of Lebanon, under *A. asclepiadeum* (Tohme and Tohme, 2007).

Phenology: The plant sprouts after the first strong rains during November. Leaves can be seen in December. In Early March one can see the bud inflorescence above ground. Blooming takes place in late March to April, but occasionally it starts earlier in early March and finishes later in early May. Fruit is developing during May becoming dry in early June; seeds are dispersed in June-July.

Geographic distribution, habitats and ecology: The plant was found in the Upper Galilee. It grows in open sunny patches with herbaceous vegetation at edges of *Quercus calliprinos* maquis on terra-rossa soil within hard limestones and on basalt soil within basalt rocks. Its distribution range is detailed in the Red Data Book (Shmida et al 2011) - 23 sites are approved from Mt. Meron area and eastwards to Mt. Cna'an, Kerem Ben Zimra, Dalton plateau and Malkia, all at altitudes between 700 and 1100m (Fig.

13). An important collection from South Lebanon (road between Marjayun and Kaukaba, 1947, G **8768**) and a photograph in the Illustrated Flora of Lebanon (Tohme & Tohme, 2007) confirm that this species occurs in Lebanon. Further study is needed to see how much north this species occurs. Chorotype: East Mediterranean.

### 3. *ALLIUM ORIENTALE* ALLIANCE

In the original description (Diagn. pl. orient. sér. 1, 13:25, 1854), *A. orientale* was characterized as having sub-undulate, plane, canaliculated-plicate, thickish leaves shorter than the scape, pedicels which are 3 times longer than the white or pale red flowers, filaments slightly shorter than the tepals, and ovate and nearly smooth ovaries and capsules. Seven vouchers from Asia Minor, Syria, Mesopotamia, and the Arabian Desert were mentioned. Later in “Flora Orientalis” (vol. 5:282 f., 1882), Boissier changed the description. He did not mention the flatness and relative length of the leaves but the leaf number as 2-6, mentioned white or red tepals becoming flaccid or sub-reflexed after anthesis, filaments  $\frac{1}{4}$  shorter than tepals, and omitted the characters of anthers, ovary and capsules. Thus this name became applicable to rather different plants (vouchers from Cyprus, Palestine, and more places in Asia Minor were also added) including those having red spots at the base of filaments and others with very broad leaves which were explicitly mentioned in “Flora Orientalis”. De Wilde-Duyfjes (1976) included even *A. gayi* Boiss., *A. aschersonianum* Barbey, and *A. telavivense* Eig. However, such a broad concept is not at all supported by molecular data. As Fig. 1 shows, material of *A. orientale* s. lat. from southern Turkey is only very distantly related to plants from Israel also named *A. orientale*. *Allium aschersonianum* and *A. telavivense* occupy likewise separate positions. Thus also the Turkish and the Israel plants belong to different species, but which of them must correctly be named *A. orientale*?

The answer seems easy, because de Wilde-Duyfjes (1976:200) designated the sheet “Cilicia Aucher 2188” housed at G as lectotype. However, search for this lectotype at G gave an unforeseen result: Two sheets bear the cited label but present different plants, and none of these sheets bears a notice by de Wilde-Duyfjes. Therefore an epitype must be chosen:



***Allium orientale*** Boiss., Diagn. pl. orient. sér. 1, 13:25, 1854.

**Epitype:** Here designated, housed in G-Boiss. The sheet labeled “Cilicia Aucher 2188” containing two scapes with inflorescences, one bulb part with two undulate, 1-2cm wide, shortly attenuate leaves, and an extra part of a bulb.

A second sheet at G with an identical label contains one complete plant and a second plant without bulb having very narrow leaves (picture available via <http://www.ville-ge.ch/musinfo/bd/cjb/chg/index.php?lang=en>). These plants represent probably shade forms having grown in the shadow of bushes or among dense grasses. The characters of this epitype agree well to the protologue as well as to the description in “Flora of Turkey” (Kollmann 1984:203) for Turkish plants when characters of reddish, pink, or lilac-pink flowering plants are ignored. There Kollmann (l.c.) also mentioned the differences between Turkish *A. orientale* plants and those from Palestine; we share her observations. The plants we collected in southern Turkey own rather flat, 1-4cm wide, undulate leaves adpressed to the soil, rather thick, gleaming white, (long-) elliptic, obtuse tepals with a green median vein, triangular white filaments about  $\frac{3}{4}$  as long as the tepals, and depressed-globose, slightly furrowed, glossy ovaries becoming blackish when in full anthesis and again green afterwards. The plants we studied from Israel and its surroundings differ by recurved, canaliculated, gradually attenuate leaves (Fig. 11), translucent white,  $\pm$  narrowly ovate, acute tepals only slightly longer than the long-triangular, whitish filaments, and glossy, permanently green ovaries (Fig. 10). They are here described as a new species:

***Allium israeliticum*** Fragman & R.M. Fritsch, **sp. nov.**

- *A. orientale* auct. (Fig. 9).

**Holotype:** **Israel.** Judean foothills, Zakariya to Bet Guvrin. 20.03.1952, leg. G. Orshansky (HUJ no. **18283**).

**Diagnosis:** Differt ab *Allio orientale* turcico foliis canaliculatis paulatim attenuatis recurvatis, tepalis translucentis acutis et ovariis permanente viridibus.

**Description:** Bulbs subovate, 2-3cm long, 1.5-2.5cm in diameter. Leaves 2-6 (10), thickish, recurved, canaliculated, gradually attenuate, 0.8-2.5cm wide, 15-30cm long, smooth, lower side with distinct longitudinal ribs, glaucous. Scape 15-25 (40)cm long, flexuous, terete, narrowly conical widest below the

inflorescence, green, upper part often brownish suffused. Spathe paper-like, whitish-brownish with brown veins, as long as the pedicels, incompletely split into 3-4 acute, finally deflexed valves. Inflorescence fasciculate, finally often semi-globose, dense, 10-50-flowered. Pedicels thickish, slightly incurved, 1.5-2 times of tepal length. Flowers cup-shaped star-like. Tepals translucent white,  $\pm$  narrowly ovate, acute, 6-8mm long, 1.5-2 (inner tepals 2.5)mm wide, median vein greenish (Fig. 10, 12). Filaments only slightly shorter than tepals, narrowly triangular, whitish, with yellow anthers. Ovaries depressed-globose with shallow furrows, c. 3mm in diameter, glossy, permanently green. Style slightly conical, 3-5mm long, whitish, with a white punctiform stigma. Capsule depressed-globose, three-angled, 6-8mm long and in diameter, widely opening, valves broad-elliptic.

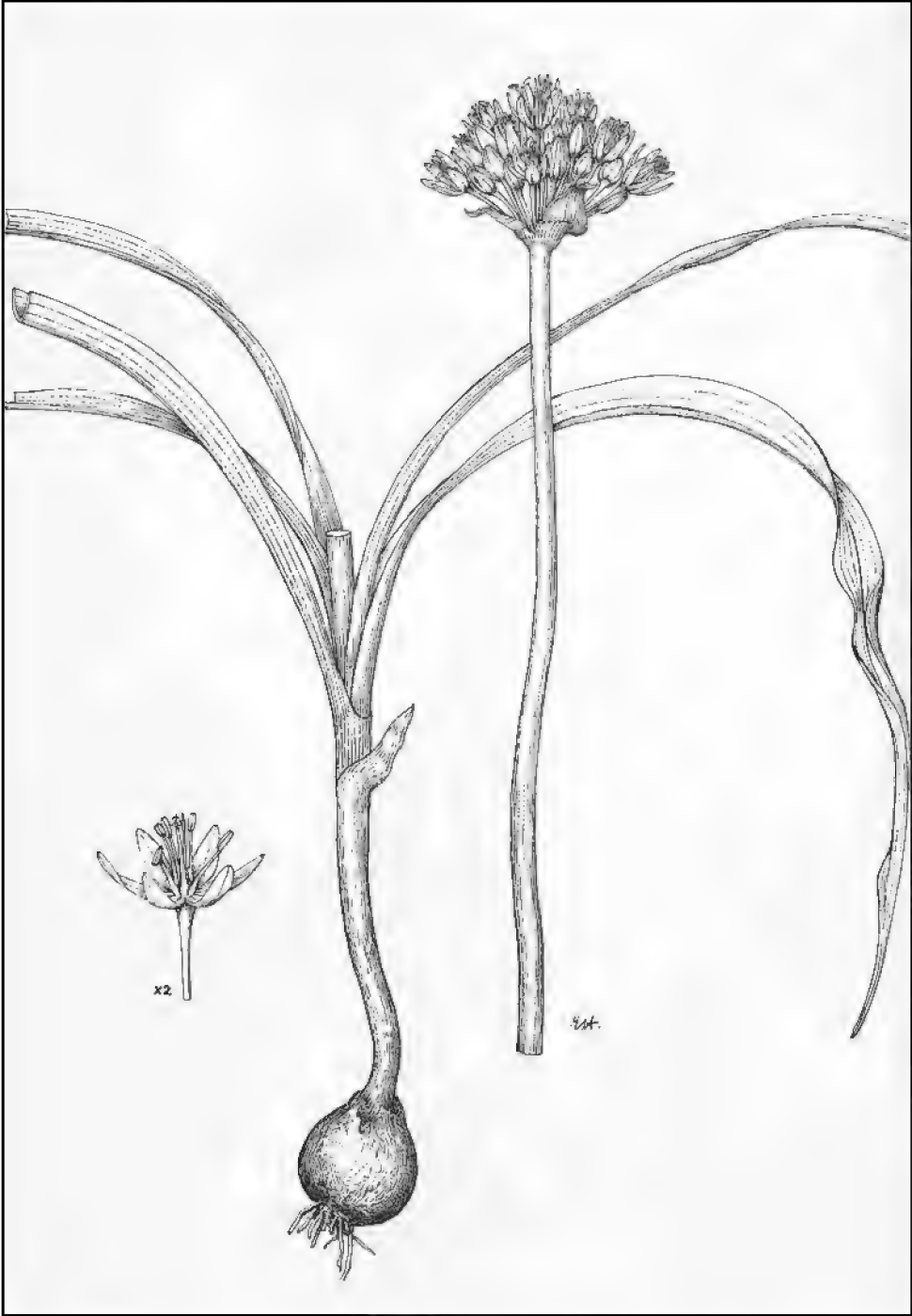
Illustrations: Flowers of the East Mediterranean (Fragman et al 2001) opposite p. 292 under *Allium orientale*.

Paratypes: Israel, north Negev, 10 km west of Arad, 19.03.1967, leg. A. Danin (HUJ no. 6256); Israel, Mt. Gilboa above Ein Harod, 21.02.1924, leg. M. Zohary (HUJ no. 6228); Israel, El Hama, 13.03.1945, leg. N. Feinbrun (HUJ no. 6288); Jordan, near Amman, 14.04.1929, leg. A. Eig & M. Zohary (HUJ no. 6290)

Phenology: The plant sprouts after the first strong rains during November. Leaves can be seen in December, and in February the bud inflorescence is visible above ground. Blooming takes place in March, but occasionally it starts earlier in late February and finishes later in early April. Fruits develop and become dry during April-May, seeds are dispersed in May-June.

Geographic distribution habitats and ecology: The plant is found in Israel, the Palestinian Territories and Jordan (Fig. 13). It grows in diverse habitats, mainly in *Sarcopoterium spinosum* batha and also in other open habitats such as herbaceous pastures, in fallow fields and sandy plains. It prefers calcareous soils, but is also found in basalt, loessial and sandy soils. It is especially common in the transition zone between the Mediterranean region and the desert, an area with average annual rainfall of 200-400mm stretching southwards from the Lake of Galilee area in the north to eastern Lower Galilee, eastern Samaria, eastern Judea, Judean foothills, the southern coastal plain and northern Negev. It is rare in the Upper Galilee, Menashe Hills, Sharon, Moav in Jordan, and Jezreel Valley. Further studies are needed to confirm if this species occurs also in the arid parts of Syria.

Chorotype: East Mediterranean (W. Irano-Turanian).



**Fig. 9.** Drawing of *A. israeliticum* (Naomi Feinbrun-Dothan, *Flora Palaestina IV*, Plates, Jerusalem; The Israeli Academy of Sciences and Humanities, 1986, plate 134).



**Fig. 10.** Inflorescence of *A. israeliticum*, S. Israel - Pura Nature Reserve.



**Fig. 12.** Inflorescence of *A. israeliticum*, N. Israel, Ramot Menashe. (photograph by Y. Marta).

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We would like to thank Prof. Avinoam Danin who connected the authors, Prof. Avi Shmida for distribution data, Adi Ben-Nun of the Hebrew University GIS Unit for the map compilation, and Hagar Leschner and Lily Steier for identifying sites in the old herbarium sheaths. We also thank Ch. S. Christodoulou for collecting material in Cyprus as well as many other colleagues for sending samples from their home countries or their collections specifically for the investigations presented in this paper.

R.M.F. would like to express sincere thanks to IPK Gatersleben for working facilities and laboratory work, especially to Dr. Maia Gurushidze for editing the sequences and computing the dendrograms, and to Dr. Frank Blattner for permanent interest in this investigation and improving the English.

**Photographs by Ori Fragman-Sapir unless otherwise stated.**



**Fig. 11.** *Allium israeliticum* in a semidesert herbaceous pasture, S. Israel, Tel Krayot.

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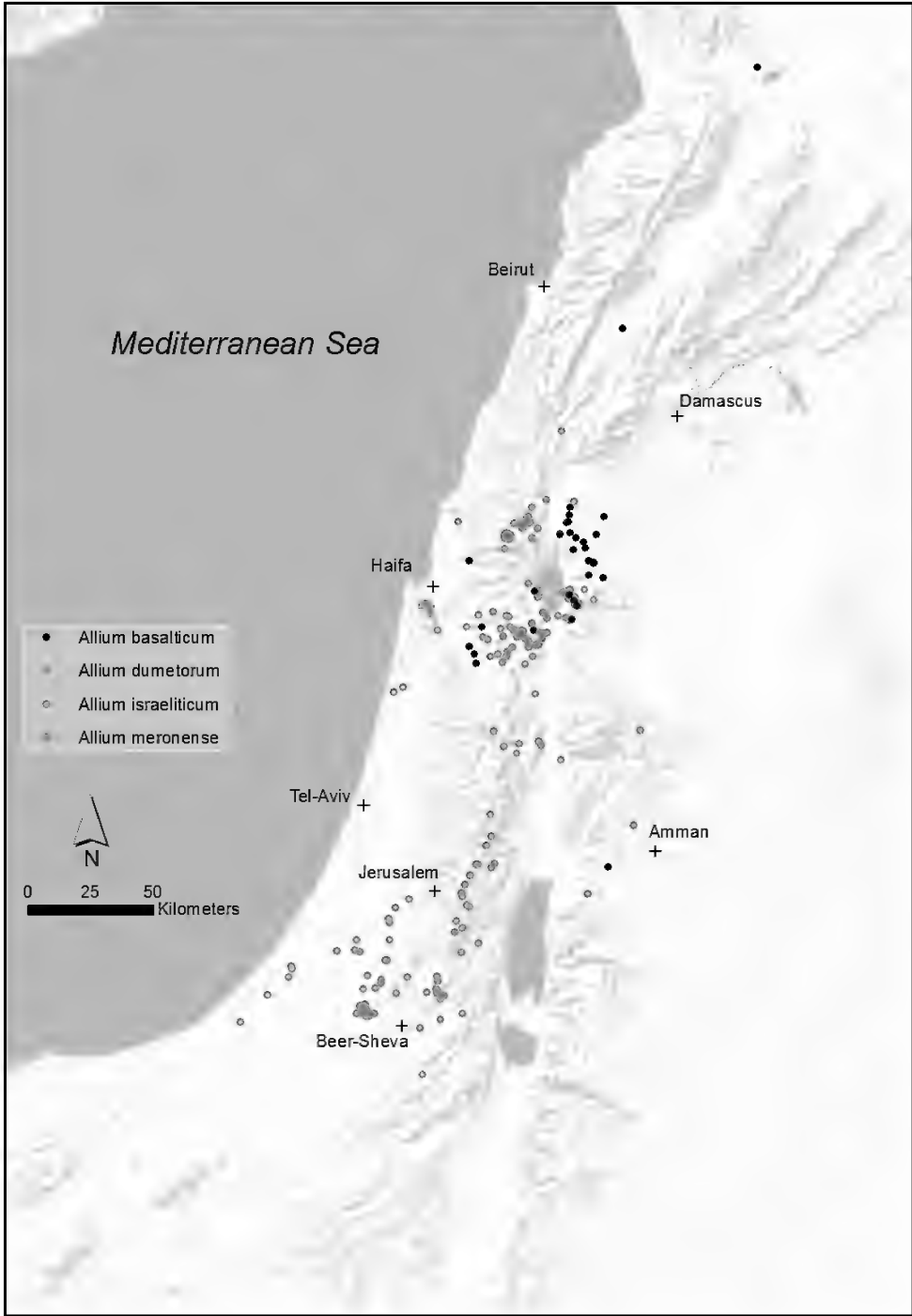


Fig. 13. Distribution map, based on Rotem Data-Base (Shmida, 2000), herbaria HUJ, G and B, and author's observations.

# **ORNITHOGALUM GILDENHUYSII (HYACINTHACEAE), A NEW CLIFF-DWELLING BULBOUS SUCCULENT FROM THE NORTHERN CAPE (SOUTH AFRICA)**

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*Ornithogalum gildenhuysii* van Jaarsv. from sheer rock-faces northwest of Springbok in the Northern Cape is described. The bulbous genus *Ornithogalum* L. (about 200 species) is particularly well represented in the winter rainfall region of the Western and Northern Cape (Obermeyer 1978; Manning & Goldblatt 2003). Recent field studies on cliffs associated with dry river valleys have revealed several taxa new to science (Van Jaarsveld & Van Wyk 1999, 2003, Van Jaarsveld 2003), including this summer-dormant species. The new species described in the present paper belongs to subgenus *Osmyne*, a group of 8 species found in the semi-arid winter-rainfall regions of Namaqualand and Namibia. Subgenus *Osmyne* is characterized by its summer dormancy and narrow elliptic white or yellow petals bearing a broad dark green central band. The stamens and filament are subulate and the style longer than the ovary and exerted above the stamens (Obermeyer 1978). *Ornithogalum gildenhuysii* appears to be an obligate cremnophyte and is only known from sheer cliffs along the Skaaprivier Poort (between Steinkopf and Springbok) in Namaqualand. Plants grow in rock crevices and leaves become pendent with age.

***Ornithogalum gildenhuysii* van Jaarsveld sp. nov.**

Species ab *O.suaveolente* (Jacq.) Oberm. bulbis maioribus, globosis ovoideisque, 25-60 × 25-70mm metientibus, foliis rosulatis, lineari-lanceolatis, 250-1000mm longis, 10-42mm latis, racemis 200-450mm longis, perianthiis nutantibus satissime discedit.

Type: **South Africa.** Northern Cape, 2917 (Steinkopf): Cliffs overlooking the Skaaprivier Poort, between Steinkopf and Spektakel, (–BC), 19-09-2007, Van Jaarsveld, Harrower, Nicolson & Xaba **21110** (NBG, holo.).



**Description:** Plants bulbous, hypogeous, solitary or dividing forming small groups. Bulbs globose-ovoid, up to 25-60 × 25-70mm; tunics thin, greyish green; roots whitish. Leaves 3-7, synanthous, 250-1000 × 10-42mm, dorsiventrally flattened, clasping at the base, ascending to horizontally spreading, becoming pendent, lorate-lanceolate, acuminate; surface dark green, softly semi-succulent, smooth, faintly striate, margin entire, lower surface with slight keel, the midrib prominent; apex acute, mucronate; juvenile leaves linear, subterete, softly succulent; apex acute. Inflorescence 200-450mm long, 1 per bulb. Raceme 80-220mm long (9-15-flowered); scape ascending, terete, 110-230mm long, 3-4.5 mm in diameter at base, and same colour as leaves; bracts, ascending, linear-lanceolate, acuminate, clasping pedicel and channeled at base, 8-10 × 1-1.5mm, becoming smaller upwards; pedicel up to 15mm, long, ascending, becoming shorter upwards. Perianth, nodding 15-18mm in diameter; tepals reflexed, yellow (with a broad green central band), narrow-elliptic, 10-12 × 3-4mm. Stamens 7-8mm long; filaments yellow; subulate, inner expanded below; anthers 2mm long. Ovary oblong, abruptly tapering at apex, 8 × 2mm, green, 3-ridged, sessile. Style 1, erect, 7.5mm long yellow; stigma capitate. Capsule ovoid, thinly coriaceous, 10mm high and up to 13mm in diameter; seed flat, half-moon shaped, black 3×2mm.

**Phenology:** *Ornithogalum gildenhuijsii* flowers during spring (September-Oct). Seeds are dispersed by wind in summer and early autumn (October onwards).

**Distribution and habitat:** *Ornithogalum gildenhuijsii* (Fig. 1, 2) is known only from vertical quartzitic sandstone cliffs (all aspects, but more often on south-facing ones) in Namaqualand Blomveld (Namaqualand Hardeveld Bioregion) of the Succulent Karoo Biome (Mucina & Rutherford 2006) between Spektakelpas and Bulletrap. It occurs in Skaaprivier Poort, the latter a river (drainage line) of ± 35km length which cuts a deep gorge parallel (north-south) to the coast. The Skaaprivier and its Doringrivier tributary drain the Steinkopf and Okiep region. The plants are locally abundant, sharing their habitat with cremnophilous species such as *Bulbine pendens* (southernmost record), *Rhadamanthus montanus*, *Colpias molle*, *Adromischus alstonii*, *Crassula montana* subsp. *montana* and *Tylecodon petrophilus*. The south-facing cliffs are cooler, with shady conditions throughout most of the winter. It grows at 300-500m altitude, in acidic, mineral-poor soil, scattered among rocks and in fissures. The



Fig. 1. *Ornithogalum gildenhuisii*, plants in habitat.

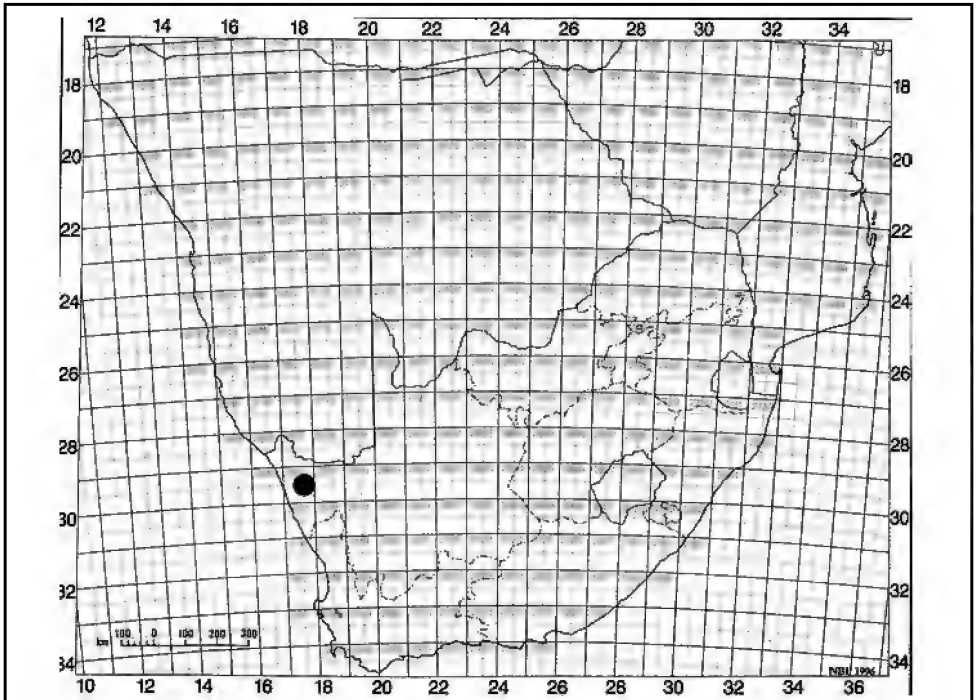


Fig. 2. Known distribution of *Ornithogalum gildenhuisii* (solid dot).

predominantly winter rainfall ranges from  $\pm$  200-300mm per annum. Summer temperatures are high during the day, with an average of  $\pm$  30°C. Winters are cooler but frost is absent.

Plants of *O. gildenhuijsii* are locally common, consisting of small hypogeous clusters. The species may completely fill a single crevice with bulbs often compressed between the sandstone rocks. Plants are pollinated mainly by insects.

Diagnostic features and affinities: *Ornithogalum gildenhuijsii* clearly belongs to subgenus *Osmyne* (Salisb) Bak. and is related to a group of xerophytic species from the Namaqualand region. In floral features it is closest to the widespread *O. suaveolens* Jacq. Oberm. (Obermeyer 1978). From *O. suaveolens* it is distinguished by its larger size (see table) as well as dorsiventrally flattened leaves to 1000mm long and becoming pendent as well as its nodding perianth and reflexed segments. *Ornithogalum suaveolens* is smaller (bulb only up to 20mm in diameter) with narrower channeled ascending leaves up to 400mm long and ascending spreading flowers. The latter species is not a cliff-dweller, occurring on flats and hills.

The leaves of *O. gildenhuijsii* wither during late October, becoming yellowish green and deciduous in summer. The capsules ripen during early summer; the black, flattish seeds are shaken from the capsules and are wind-dispersed in summer.

Cultivation: Plants are easily grown from division and thrive well in cultivation but should be kept dry during summer.

Etymology: The specific epithet honours Danny Gildenhuijs (May 18, 1946-) who assisted the author on the expedition as well as growing and providing the live specimens to the botanical artist, Mrs. Vicki Thomas. Danny is a local bulb expert who has assisted the author for a number of years.

**TABLE 1.** Main vegetative and floral differences between *Ornithogalum gildenhuysii* and *O. suaveolens*.

	<i>O. gildenhuysii</i>	<i>O. suaveolens</i>
Habitat	Cliffs	Level ground
Bulb	25-60 × 25-70mm	20mm in diameter
Leaf shape	lorate-lanceolate, 250-1000 × 10-42 mm, dorsiventrally flattened	Linear-acuminate, ascending 100-400 × 20-30mm, canaliculate
Perianth	Nodding (facing towards ground)	Spreading to ascending

#### ACKNOWLEDGEMENTS

I thank Vicki Thomas for her beautiful painting of *Ornithogalum gildenhuysii*, and colleagues Phakamani Xaba, Greg Nicolson, Adam Harrower, Dale Parker, Danny Gildenhuys, Phillip Nel, James Deacon and Dicky Peterson for their assistance in the field during the Skaaprivier Poort expeditions.

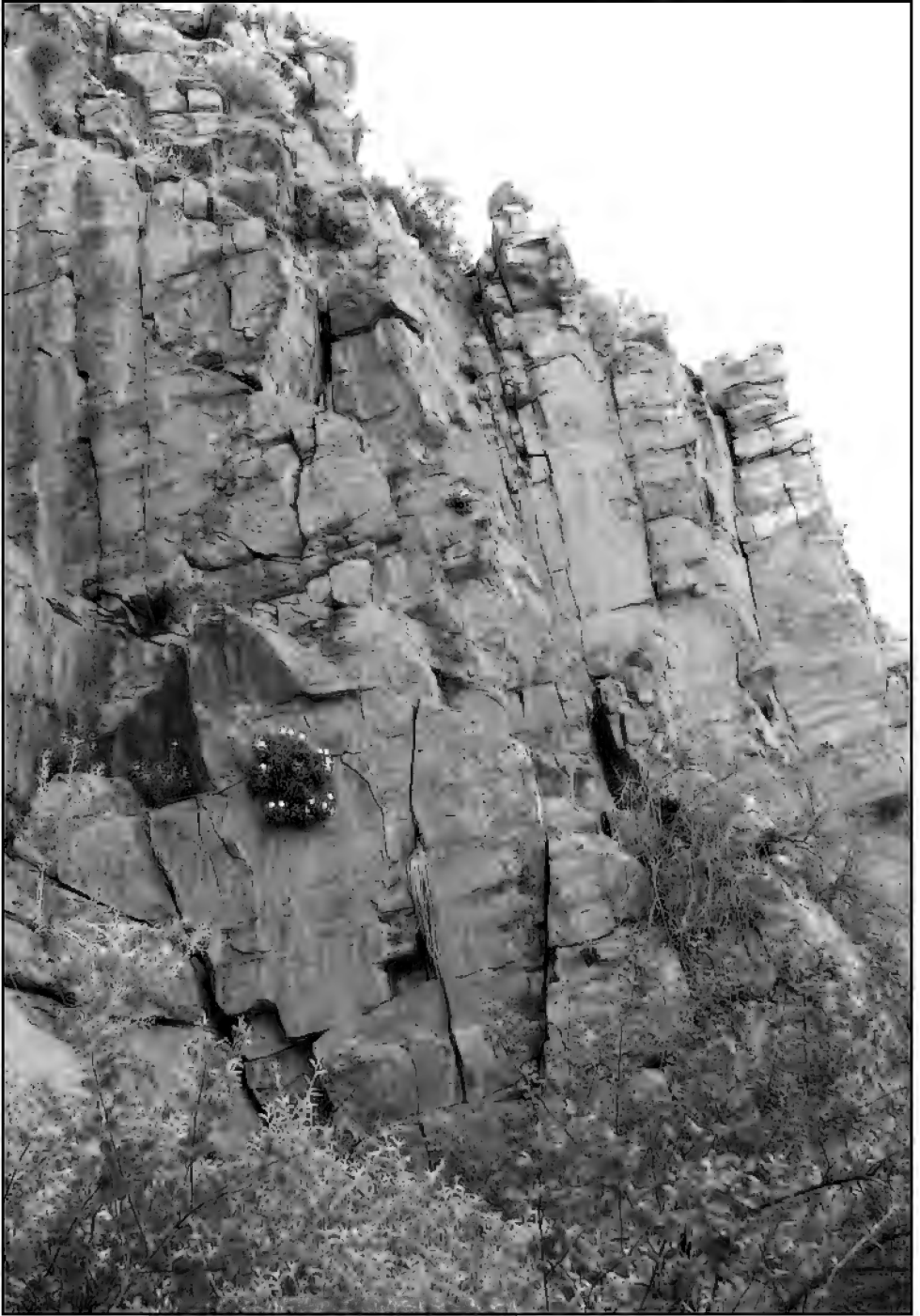
**All photographs by the author.**

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**Fig. 3.** Close-up of *Ornithogalum gildenhuysii* plants in habitat at Skaaprivier Poort.



**Fig. 4.** The cliff-face habitat of *Ornithogalum gildenhuisii* at Skaaprivier Poort.



**Fig. 5.** Plant in habitat at Skaaprivier Poort.



**Fig. 6.** *Ornithogalum gildenhuysii*, illustration by Vicki Thomas, from a plant grown by Danny Gildenhuys.



## **TULBAGHIA MARITIMA: A NEW SPECIES FROM THE SOUTHEAST CAPE PENINSULA, SOUTH AFRICA (ALLIACEAE)**

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On the basis of important morphological features (Fig. 1, 2, 3), of its restricted coastal habitat and distribution (Map 1, Fig. 4), and of a re-evaluation of all the evidence, we propose to change the status of var. *maritima* Vosa of *Tulbaghia violacea* Harvey to the rank of species. We propose also to adopt as *typus* the same specimen used to establish the variety (Fig. 3).

All the wild populations of this taxon are very homogeneous in overall morphology and the only variable character seems to be that of flower colour and sometimes size. The populations are all found in the same kind of habitat, growing usually in sandy soil among rocks, generally very near the seashore (Map 1, Fig. 4). A typewritten note on herbarium specimen H.G. Fourcade **10.840** (RU), collected near the seashore at the Twee River Mouth in January 1910, points to the existence of a mixed population of typical *Tulbaghia violacea* with a different type of plant which Henry G. Fourcade, one of the major early collectors of the Cape Flora, noting the outstanding differences, labeled *Tulbaghia* sp. near *violacea*.

This situation has been confirmed by a visit to the very same site by the present author, more than one hundred and one years later, on the 15th of January 2011. In fact, the two entities still exist almost side by side on the site but now are reduced to a few scattered plants. A certain amount of trampling and various kinds of tourist developments are responsible for the drastic reduction of most of the spontaneous vegetation of the site.

The existence and persistence at least over a century of a mixed population of *T. violacea* and of the taxon in question is very interesting and of great importance to support the proposal of a change in status

of var. *maritima* to the rank of species in its own rights. A further and determinant reason for the change is given by breeding experiments, carried out during the course of this study, which have established that the two entities can be easily crossed artificially giving rise to intermediate forms. Thus, a mixed population, with the two entities keeping morphologically and therefore genetically distinct, highlights their diverse specific status clearly implying the existence of a very efficient separating mechanism probably at the pollen vectors level.

Besides the special coastal habitat and restricted distribution, the proposed new species differs from *Tulbaghia violacea* Harv. (Fig. 2) in the following characters: 1) broader and shiny dark-green round-tipped leaves which are practically keel-less for most of their upper part; 2) the incurved edges of the blunt and longitudinally slightly ridged perianth segments held flat at right angle to the perianth tube; and 3) the small yellowish to deep orange staminodia (Fig. 1, 3).

**Typification:** *Tulbaghia maritima* Vosa, **species nova**.

syn. *T. cepacea* Linn. fil. var. *maritima* Vosa (Vosa, 1975).

*T. violacea* Harv. var. *maritima* Vosa (Vosa, 2000).

**Diagnosis:** planta media ab species violaceae caudex parvo et folia atro-viridia nitida, breve, latiore et superne ecarinata, segmenta perianthium obovata et per totam longitudinem porcata, margine incurvatus, apex obtusus etiam habitat plerunque maritimus differt.

**Holotypus:** **South Africa.** Cape 3323 (Port Elizabeth): Gamtoos River Mouth, growing in sandy soil near rocks, 30th September 1969, Vosa **290/12** (OXF), Fig. 3.

**Chromosomatum numerus:**  $2n=2x=12$ , Group 2 (Vosa, 1975, 2000, 2009b).

Selected list of specimens:

1. 3224 (Humansdorp): near the mouth of the river Kroomme, Vosa **63** (OXF).
2. 3323 (Willowmore): Twee River Mouth, growing in sandy soil near small wood, Vosa **65** (OXF).
3. 3323DD: 33°52'30"S 23°52'30"E, Ratels Bosch seashore, H. G. Fourcade **565** (NBG 256429).
4. 3423BB: 34°7'30"S 23°52'30"E. Storms River Mouth, W. Nichol **16** (NBG 88452).



**Fig. 1.** Inflorescence of *Tulbaghia maritima* Vosa. Note the flat flowers, the incurved margins of the blunt tipped and longitudinally ribbed perianth segments and the spatulated tip of the inner triplet. Note also the very small yellowish-orange coronal lobes turning to whitish and bent inwards in the fading flowers almost obstructing the mouth of the perianth tube (photo by the author).



**Fig. 2.** Typical inflorescence of *Tulbaghia violacea* Harv. Note the differences with the species *maritima* (Fig. 1) especially the lanceolate and channeled perianth segments with scarcely incurved margins and the prominent outward bent coronal lobes (photo by the author).



**Fig. 3.** Photograph of the typus of *Tulbaghia maritima* (C. G.Vosa 290/12, OXF) courtesy of Serena Marner, Manager of the Fielding-Druce Herbarium, Oxford. Note the broad blunt-tipped leaves.



**Fig. 4.** The spectacular rocky seashore at the mouth of the Storms River: the habitat of *Tulbaghia maritima*. Note the thicket vegetation covering the side of the hills and the semi-permanent sea-mist. The thicket biome is part of the Cape Floristic Region described by van Wyk & Smith (2001) which includes the Port Elizabeth area (photo by the author).

5. 3423BB: 34° 7'30"S 23°52'30"E. Tafelbank (near Daerand Baai), Tsitsikamma Coast, H. C. Taylor **9960** (NBG 256427).
6. 3424BB: 34°7'30"S 24°52'30"E. Humansdorp district, J. Thode **A1055** (NBG 256432).
7. 3323 (Willowmore): Twee River Mouth, H. G. Fourcade **566** (RU).
8. 3323 (Willowmore): Twee River Mouth seashore, H. G. Foucade **16.840** (RU). A white flowered plant.

**Description:**

**Rootstock:** a small pear-shaped corm held on a poorly defined very short rhizome.

**Roots:** very numerous, moderately fleshy and relatively short, growing mostly laterally.

**Leaves:** 10 to 15 in number, shiny, dark green, slightly ribbed longitudinally in correspondence with 8-10 vascular bundles, with rounded tips and with a visible keel only in their lowest part, generally much wider than in *T. violacea* Harv. (9 to 12mm instead of 3 to 7mm wide) and 10 to 15cm long, somewhat recumbent.

Scape: erect, longer than the leaves.

Spathe valves: 2, small, scarious at anthesis.

Pedicels: relatively short.

Umbel: 6 to 12 flowered (in robust plants).

Flowers: somewhat smaller than in *T. violacea* and often facing upwards at first anthesis, shell-pink to light purple in colour, rarely white.

Perianth tube: 7-8mm long, elongated-funnel shaped, about 5mm wide at the level of the perianth segments, internal surface of the same colour of the staminodia or a shade lighter.

Perianth segments: 4.5 to 6mm long and 2 to 3mm wide at the base, ovato-elongated with blunt tips, both outer and inner ridged longitudinally with incurved edges rather more marked in the inner segments which have a slightly cucullated tip, generally spreading flat outward at right angle to the perianth tube at full anthesis.

Coronal lobes: typical of the subgenus *Omentaria* and formed only of three separate rather small staminodia. In shape they may be blunt, emarginato-erose or sometimes more or less bifid, whitish or yellowish to deep orange in colour. The staminodia are placed at the base of the inner perianth segments and are often bent inward almost obstructing the mouth of the perianth tube as the flower fades.

Ovary: small, ovoid, obscurely mitre-shaped.

Style: very short, less than 1mm long.

Stigma: capitate, often yellowish in colour and covered with very tiny translucent hemi-spherical papillae.

Seed capsule: obovate, mitre-shaped with rounded corners, splitting loculicidally when ripe.

Seeds: black, triangular-elongated in shape, 1.5-2.5mm long.

## DISCUSSION

The contrasting colour of the coronal lobes of the new species, often deep orange, can be considered an evolutionary step towards the situation found in many species of the subgenus *Eutulbaghia* (see Sectio III of Vosa, 2009b) where the corona in most cases is the only pigmented part of the flower. This fact and the separate coronal lobes, may lead to the hypothesis that the subgenus *Omentaria* may be considered basal to its sister subgenus *Eutulbaghia*.

Regarding the specialized habitat and distribution of the new species,

there remains the problem of its propagation namely by seed dispersal. All the known sites are practically on the seashore at or very near the mouth of rivers which form rather steep gorges usually covered by thick vegetation (Fig. 4). The new species is fertile and produces a fair amount of viable seeds which necessarily will fall on the sandy shore and will be washed away by the oncoming tidal waves.

Experiments on the permeability of the seeds of the new species were carried out, using samples of about 40 seeds, with the same modality as in Vosa (1983). However, owing to the marine habitat, the experiments were made using beakers of distilled water with about the same salt concentration found near the seashore at the mouth of the Gantoos River. We took also into account the alternating seasonal fresh water input from the rivers and the average sea-surface salinity of the South-Western Indian Ocean with an overall seasonal variation of 3.2 to 3.7% (a very informative discussion on this matter can be found in Donguy and Meyers, 1996). Our experiments have shown that 60 to 70% of the seeds remain afloat for about 15 hours with no apparent loss of viability. This length of time may be considered sufficient for at least some of the floating seeds to be carried away by the ebbing tides and by the inshore currents to suitable germination and growing sites. A study at high magnification ( $\times 40$ ) as well as by Scanning Electron Microscopy (Vosa, 1983, 2003) on the finer morphology of the seed-coat patterns of *T. maritima* has revealed that the probable reason for the reduced permeability of the seeds may be found in the ribbon-like sutures between the cells forming the seed-coat (type B of Vosa, 2003 and see Fig. 5). Moreover, the peculiar raised markings on the seed-coat seem to favour the formation of an air-layer which may further ensure the floating of the seeds by water-surface tension.

With addition of this new species, the subgenus *Omentaria* (Salisb.) Baker of the genus *Tulbaghia* L. consists now of the following taxa:

*T. violacea* Harvey

*T. violacea* Harvey subsp. *macmasterii* Vosa

*T. cominsii* Vosa

*T. maritima* Vosa

## APPENDIX

Most of the known sites of distribution of *T. maritima* were visited recently (December 2010 and January 2011) by the author. According to his

experience of previous visits (September 1969, October 1979 and 1982), these sites, which were formerly inhabited by consistent populations of the new species, appear now, for the most part, very much altered; so much so that, in some cases, i.e., at the Storms River Mouth site, the natural coastal vegetation has been in places almost completely wiped out by developments such as the construction of new roads, paths, large parking spaces and other tourist facilities. The present author considers desirable the establishment of some measures of protection for what remains of the habitat not only of the new species but also of the very important coastal vegetation of the Western and Eastern Cape as a whole, as they are nowadays under going extensive tourist development.

#### ACKNOWLEDGEMENTS

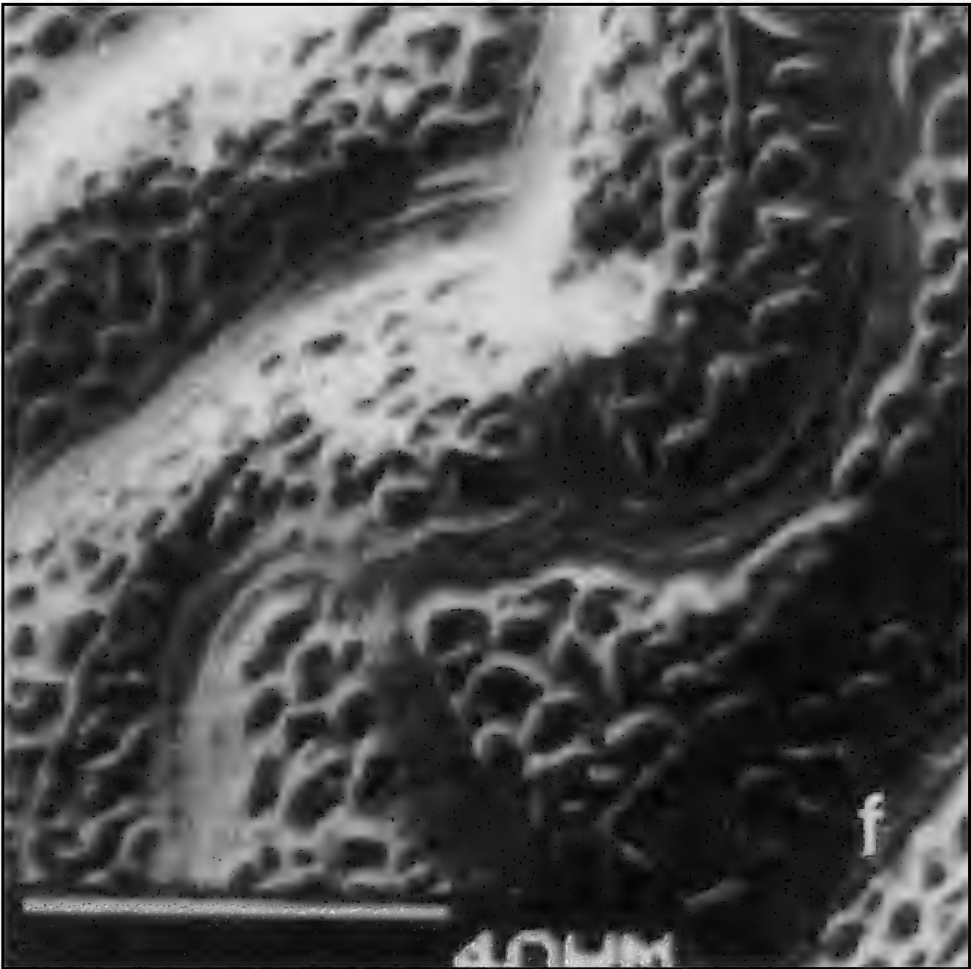
I am very grateful to the many people worldwide for their help and fruitful discussions during the course of the study, especially Dave Fenwick and Liz Powney, owners of specialized nurseries in Wales (U. K.), for welcome gifts and for information on important research material. I wish also to thank particularly Dr. Dee Snijman of the Compton Herbarium (NBG), Tony Dold, Curator of the Selmar Schonland Herbarium (RU), Prof. Eileen Campbell, Curator of the Ria Oliver Herbarium (PEU), Serena Maener, Manager of the Fielding-Druce Herbarium (OXF), and Dr. Giuseppe Pistolesi, Curator of the Botanic Garden of Pisa (Italy) for their valid help and kind collaboration.

*In memoriam:* Professor Emilio Battaglia, eminent tutor in cytogenetics and a very dear friend.

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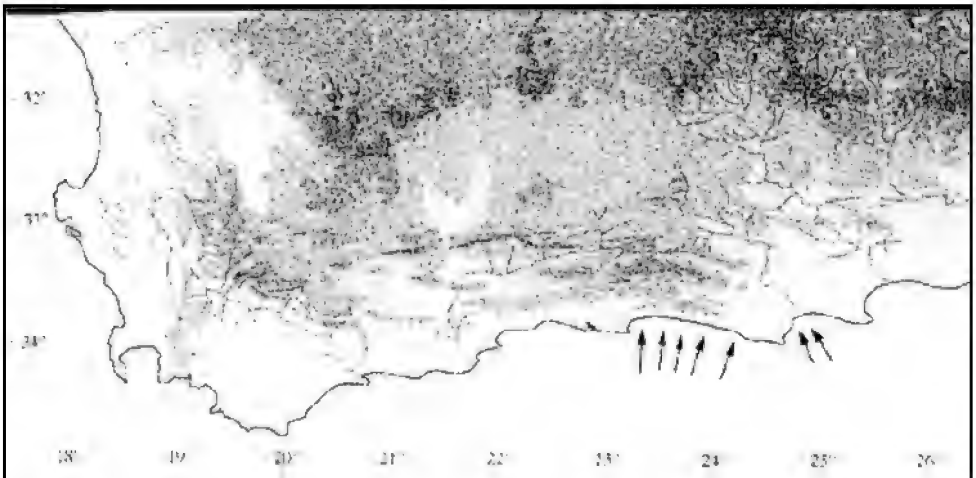
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**Fig. 5.** Scanning Electron Microscope photograph of the seed-coat of *T. maritima*. Note the ribbon-like sutures between the elongated cells and the peculiar raised markings on the cell surface (from Vosa, 1983, 2003).

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**Map 1.** The arrows show the approximate locations of some of the sites of *T. maritima* in South Africa. The very restricted distribution area of the new species just straddles, to the West, the boundary between the Eastern and the Western Cape Provinces. All the locations are situated less than 20m from the seashore.

## TOPOTYPE SELECTION FOR *CRINUM FORBESII* HERB. EX LINDL. EMEND. HERB. (AMARYLLIDACEAE)

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### INTRODUCTION

When John Lindley (1826a), then Assistant Secretary of the Horticultural Society of London, published a new taxon identified as *Amaryllis forbesii*, he certainly could not have envisioned that 180 years later botanists would still be arguing over its identity. Apparently Lindley did not deposit a herbarium specimen of *Amaryllis forbesii*, but the plant was illustrated – William Herbert (1837) alluded to such a drawing (or painting) possessed by the Horticultural Society of London, but it was never published. Unfortunately the Horticultural Society of London experienced severe financial difficulties in the 1850s, and in 1859 its library and botanical drawings were sold at auction (Gunn et al., 1981). Furthermore, the original bulbs that had been collected by John Forbes in 1822 at Delagoa Bay, Mozambique, proved to be tender and rotted within a few years (Herbert, 1837). Hence, later investigators were left with only the accounts of Lindley and Herbert, the two botanists who published first-hand descriptions.

The taxonomical history of this species became enmeshed in a tangled web involving multiple botanists, epithets, and herbaria which has continued to the present day. The following account summarizes the pertinent literature in chronological order, discusses the conflicting issues, and concludes with a formal designation of a topotype for *Crinum forbesii* Herb. ex Lindl. emend. Herb. To avoid confusion when reading this account, *Amaryllis forbesii*, *Crinum forbesii*, *Crinum forbesianum*, *Crinum delagoense*, and *Crinum stuhlmannii* are treated as the same species and are used interchangeably.

### THE PROBLEMATIC HISTORY

#### 1. Herbert (1825): Curtis's Botanical Magazine t.2592

Following his account of *Crinum elegans*, Herbert (1825) enumerated additional interspecific *Crinum* hybrids to supplement the list he had

previously published in his Appendix (Herbert, 1821). One of the reported new hybrids was between *Crinum forbesii* and *Crinum careyanum*. This represented the initial publication where the taxon *Crinum forbesii* appeared – no description or other details were provided.

## **2. Lindley (1826a): Transactions of the Horticultural Society of London p. 87**

In his initial account, Lindley remarked: “Many fine bulbs, some of them nearly as large as a man’s head, of this new species of *Amaryllis*, were sent from Delagoa Bay by Mr. John Forbes, ... Some of the plants produced above 30 flowers of the most delicate pink colors. ...they are kept in the stove, but no seed has yet been obtained from them.” Lindley provided a brief specific description:

*A. forbesii* – umbels multi-flowered (30-40); leaves narrow, canaliculate, weak, glaucous, ciliate; long campanulate flowers.

## **(1826b): Transactions of the Horticultural Society of London p. 285**

In a subsequent account, Lindley reported on “*Amaryllis forbesii* β, *purpurea*”. He remarked: “...a variety flowered, which exceeded in the beauty of its blossoms the first which was seen. The whole of the colour, which in the original variety is of a delicate pink, was in this changed to a rich purplish crimson, resembling the colour of *Crinum amabile*. A smaller number of flowers was produced in the new variety, and the divisions of the flower appeared more revolute than in the kind first seen; otherwise they were not observed to differ.” He did not provide any additional descriptive details.

## **3. Schultes & Schultes (1830): Systema Vegetabilium Pp. 864-865**

Schultes & Schultes published *Amaryllis forbesii* as *Crinum forbesii*, giving Lindley a full citation and repeating Lindley’s description. In addition, they cited Herbert’s report in Bot. Mag. t.2592 of the interspecific hybrids between *Crinum forbesii* and *Crinum careyanum*. Thus Schultes & Schultes were aware that Herbert earlier had classified *Amaryllis forbesii* as a *Crinum*.

## **4. Herbert (1837): Amaryllidaceae Pp. 32-33, 260-267**

In the Preliminary Treatise which begins Amaryllidaceae (Pp. 32-33), Herbert expressed concern for how species, varieties, and hybrids were being assigned Latin epithets without any regard for order – there was

major confusion since no nomenclature standards existed. Thereupon, Herbert detailed a new scheme: “It would very much tend to preclude confusion if all substantive genitive cases were abandoned to cultivars for the distinction of their varieties, and the names of all species and permanent local varieties confined to adjectives.” He listed examples; species were to be written in the Latin adjectival form, man-made hybrids in noun form. Therefore, when Herbert published *Crinum forbesianum* in Amaryllidaceae, the name indicated that it was a species – to have used *Crinum forbesii* would have meant that it was a hybrid.

When Herbert published *Crinum forbesianum*, he referenced Lindley’s initial publication, and he cited a colored (painted) illustration in the possession of the Horticultural Society of London. Herbert’s specific description was:

Broad Category: Flowers half-patent\* (\*subgenus *Codonocrinum*)

General: Leaves not undulating, umbel pedunculated, flower less patent, cells with many ovules, South Africa.

Specific: Bulb a large sphere; leaves lorate, canaliculate, glaucous, ciliate; umbel 30-40 flowers; flowers luxuriously purple.

Var. (fortuitous) *punicea*. Ib. Flowers richly purplish-crimson with recurved tips.

Herbert remarked: “The bulbs were very large, but of difficult culture, and I fear that they may have been all lost by rottenness. I believe the exposure of the bulbs to our damp atmosphere has been the cause of their perishing.” Herbert also related that the hybrids mentioned in Bot. Mag. t.2592 had resulted from applying pollen of *C. forbesianum* onto *C. careyanum*, and that pollen of *C. forbesianum* had failed to impregnate *C. capense* (*C. bulbispermum*).

## 5. Baker (1881): Curtis’s Botanical Magazine t.6545

Baker’s stated purpose in publishing Bot. Mag. t.6545 (Fig. 1-2) of *Crinum forbesianum* was: “It appears to have soon been lost out of cultivation, and as no figure nor specimen was preserved, it passed into the rank of doubtful species, till it was sent to Kew in 1877 by the late Mr. J. J. Monteiro, ...” Along with the bulb that he collected at Delagoa Bay, Monteiro submitted a herbarium specimen (Monteiro 53, K; Fig. 3) including a hand-written comment that umbels contained 28-32 flowers. Baker remarked that the bulb flowered before the leaves emerged as

depicted in the small drawing located in the lower right corner of Bot. Mag. t.6545 (Fig. 2); the bulb flowered in 1878. Baker provided a detailed description that essentially agreed with Herbert's description including the leaves being "glaucous". Baker's verbatim description was:

Bulb as large as a man's head, with a short neck and copious brown membranous tunics. Leaves lanceolate-lorate, not fully developed until after the flowers, decumbent, three foot long, four inches broad, acute, glaucous, distinctly ciliated. Scape ancipitous, above an inch in thickness, pale green, at most a foot long. Flowers thirty or forty in a dense umbel; spathe-valves lanceolate-deltoid, three inches long, tinted red; pedicels erect, half or three-quarters of an inch long. Perianth funnel-shaped, seven or eight inches long, cernuous; ovary oblong, green; tube cylindrical, about three inches long; limb four or four and a half inches long, its segments oblanceolate-oblong, acute, suffused with bright red down the back, permanently connivent in the lower half, reflexing in the upper. Filaments declinate, oblong, versatile, under an inch long. Style very slender, declinate, bright red towards the tip, as long as the perianth; stigma capitate.

#### **6. Baker (1888): Handbook of the Amaryllideae p. 93**

Baker published an expanded description of *Crinum forbesianum*.

#### **7. Monteiro (1891): Delagoa Bay. Pp. 171-172**

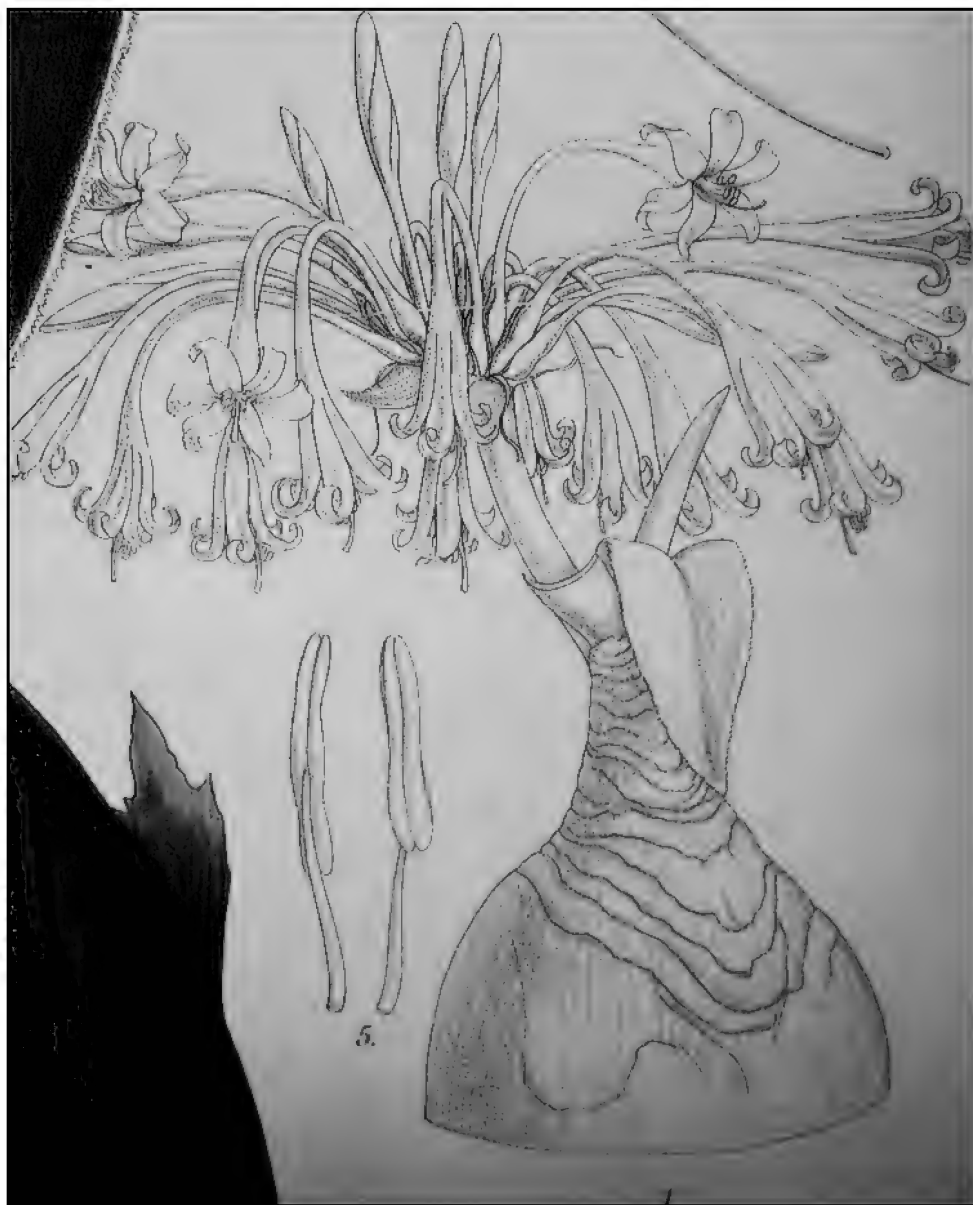
Although written as a natural history account about Delagoa Bay and not published in a botanical journal, the widow of J.J. Monteiro wrote several pages concerning field observations of *Crinum forbesianum*. She described large bell-shaped, fragrant flowers striped with crimson, the crimson stripe varying very much in width with some flowers being almost white, and umbels containing as many as 32 flowers. Her account included the initial description of fruit and seeds; the fruit being crimson red and as large as apples, and the seeds being the size of marbles and lying in a soft flannel-like pericarp. (Note: see Fig. 5)

#### **8. Baker (1898a): Flora of Tropical Africa. Pp. 393-404, 578**

The herbarium specimen depicting *Crinum stuhlmannii* was collected by the zoologist Franz Stuhlmann in 1894 at Dar es Salaam and did not include leaves (Stuhlmann 8536, B; Fig. 4). No field observations were



**Fig. 1.** *Crinum forbesii* (published as *Crinum forbesianum*), Curtis's Botanical Magazine t.6545, 1881.



**Fig. 2.** Close up of pencil drawing in lower right corner of Curtis's Botanical Magazine t.6545, 1881, depicting *Crinum forbesii* in bloom at Kew in 1878.





**Fig. 3.** Topotype specimen of *Crinum forbesii* Herb. ex Lindl. emend. Herb., Monteiro 53, October 1876, K. Photograph © the Board of Trustees of the Royal Botanic Gardens, Kew and is reproduced with the consent of the Royal Botanic Gardens, Kew.



**Fig. 4.** Type specimen of *Crinum stuhlmannii*, Stuhlmann 8536, 1894, B. Image courtesy of Röpert, D. (Ed.) 2000-(continuously updated): Digital specimen images at the Herbarium Berolinense. Published on the Internet <http://ww2.bgbm.org/herbarium/> (Barcode: B 10 0160894 / Imaged: 229023) [accessed September 27, 2009].

recorded on the herbarium sheet, and Baker did not acknowledge that any additional data was provided to him. The only additional information recorded on the herbarium sheet was that the name given to the plant by local Kisaramo speaking natives was “yungi-yungi” (translation: “blue lotus water lily”). Baker’s brief verbatim description was:

Bulb and leaves not seen. Peduncle stout (3/4 in. diam.). Umbel dense, many-flowered; spathe-valves large, thick; pedicels 1-2 in. long; flowers erect. Perianth-tube slender, 3 in. long; limb 5 in. long; segments oblanceolate, 1/2 in. broad high up. Stamens reaching the tip of the perianth segments.

Baker assigned *C. stuhlmannii* to subgenus *Stenaster* (#17a) under the subclassification of “segments as long as the tube”.

**(1898b): *Flora Capensis* Pp. 198-202**

Baker reiterated a detailed description of *Crinum forbesianum*.

## 9. Uphof (1942): *Herbertia* 9:63-84

In his review of the genus *Crinum*, Uphof placed *Crinum forbesianum* under subgenus *Codonocrinum* and included references to Baker and Lindley; he designated *Crinum stuhlmannii* Baker as “unclassified” regarding subgenus and commented: “No relationship to other species is indicated.”

## 10. Verdoorn (1962): *Flowering Plants of Africa* t.1389

Summarizing Verdoorn’s justification for publishing *Crinum delagoense*:

1) She thought that Lindley’s original description of *Amaryllis forbesii* did not fit that of *C. delagoense*, citing the delicate pink flowers and the narrow, canaliculate, glaucous leaves – “... no specimen is known from near Delagoa Bay that answers exactly to Lindley’s description ...”; 2) She repeatedly referenced *C. forbesianum* Herbert as being an illegitimate name, citing that the epithet selected by Herbert in transferring *Amaryllis forbesii* to the genus *Crinum* was against the rules of nomenclature; 3) She reasoned that the bulb(s) Herbert possessed represented a different species from those in Lindley’s possession because Herbert described a variety “*punicea*” with “flowers purplish-red, strongly revolute” – Verdoorn did not mention Lindley’s  $\beta$  *purpurea* variety in this account – Verdoorn quoted Monteiro (1891) as well in this account but omitted Monteiro’s comment about wide variation in the thickness of the crimson stripe on the flowers; 4) She fully agreed that the Monteiro specimen Baker had utilized in Bot. Mag. t.6545 for *C. forbesianum* “obviously depicts our species” (*C. delagoense*); and 5) Verdoorn concluded: “... *C. forbesii* (Lindl.) Schultes f. remains an insufficiently known species.” Verdoorn’s verbatim description for *C. delagoense* was:

Bulb tunicated, globose, 6-22cm diam., abruptly narrowed into a short or long neck. Leaves more or less spreading along the ground, 20cm to 1m long, up to 15cm broad, with a very narrow cartilaginous border and distinctly ciliate. Peduncle arcuate-ascending, up to 50cm long, 1-5cm thick, pale green suffused rose in parts. Involucral bracts with the two outer about 8cm long and 3cm wide, red or suffused with purplish red; the inner narrowly linear, about 9cm long. Umbel 10-30 flowered. Pedicels 2-7cm long. Perianth funnel-shaped; tube about 9cm long, green or suffused with red; lobes with a distinct rose-coloured keel (very occasionally the keel is only faintly coloured) about 10cm long, the three exterior 2cm wide, the interior 2.8 cm wide. Stamens with the filaments

white or suffused with rose; anthers white becoming dark brown. Style red in the upper portion. Ovary green, 1.5cm long or longer, 1cm diam. Capsule sub-globose, purplish-red or scarlet, with the persistent perianth dying back to a short crown at the base.

### 11. Verdoorn (1973): *Bothalia* 11:27-52

At the beginning of this account of *Crinum delagoense*, Verdoorn listed both *Amaryllis forbesii* var. *purpurea* and *C. forbesianum* var. *punicea* as synonyms followed by the statement: “No specimen preserved but presumably this species.” – she did not elaborate on these synonymies in the subsequent discussion. She also listed *C. forbesianum* sensu Baker as “pro majore parte, excl. syn.” (translation: in major part, excluded synonymy). In the discussion, she reiterated that *C. forbesianum* Herbert was an illegitimate name, and that it was impossible to establish what species Lindley described in his original description of *Amaryllis forbesii* and therefore it must be discarded as confused. She stated that two species in the vicinity of Delagoa Bay could fit Lindley’s original description, *C. macowanii* and *C. delagoense*, but neither “has flowers of a most delicate pink color nor leaves that are narrow, flaccid and glaucous.” Verdoorn suggested that Forbes also could have collected *C. paludosum* in the Delagoa Bay vicinity as it had relatively narrow leaves and white flowers suffused with pink, but remarked that it was not a large bulb and did not have many flowered umbels.

### 12. Nordal (1977): *Norwegian Journal of Botany* 24(3):179-194

Nordal commented: “The type material of *C. stuhlmannii* is very poor, but the characters possible to deduce, ... The species is closely related to *C. delagoense* Verdoorn, replacing the earlier illegitimate *C. forbesianum* Herb. (Verdoorn 1962). They probably represent the same species, possibly distinguishable at subspecies level.” She included a botanical drawing of *C. stuhlmannii* with her account and provided the following detailed description:

Bulb globose, diameter 12-20cm, often with a distinct neck. Leaves green, glossy and flaccidly spreading on the ground, lorate with margins parallel, the outer ones 8-19cm broad and up to 90cm long at anthesis; growth rhythm of leaves like that described for *C. macowanii*; leaf margins distinctly ciliate and not undulate; many close parallel

veins without visible transverse connection; leaves completely lacking midrib and keel. Peduncle, 1-3 together, lateral, stout, somewhat compressed, 25-65cm long, always contemporary with the leaves. Spathe valves membranous, drooping at anthesis. Inflorescence 10-21 flowered; pedicels 2.0-7.5cm long; tube red, 8-12cm long, curved; segments with a red to purplish central part fading into white or pink near the margin, linear to narrowly lanceolate, acute to acuminate, 7.5-12.5cm long, the outer 10-17mm broad, the inner 12-20mm broad, the segments connivent to a funnel, normally with the apical part distinctly reflexed; filaments white to pink, declinate, anthers yellow to light brown, curved and about 5mm long at anthesis, style deep rose, reaching the mouth of the funnel. Fruit vividly coloured, orange to deep red, globose to ovoid, most often without a beak and often reminding of apples, diameter usually 4-6cm, but up to 13cm long fruits observed, pericarp thick with a spongy inside and glossy outside. Seeds 3-20, globose or somewhat flattened, largest diameter up to 2cm, glabrous, light green, covered with a silvery to grey water repellent membrane.

### 13. Nordal (1983): *Flora of Tropical East Africa. Amaryllidaceae* Pp. 9-18

Nordal republished the illustration of *Crinum stuhlmannii* from her 1977 account and essentially repeated her description of it. No mention was made of a possible association with *C. delagoense*.

### 14. Lehmiller (1992): *Herbertia* 48:86-90

Lehmiller recounted the close personal relationship that existed between Lindley and Herbert, including their exchange of communications and sharing of botanical materials, leaving little doubt that the subject bulbs observed by both Lindley and Herbert could be traced to the Forbes Expedition. Lehmiller felt that Verdoorn's (1962) objection to Lindley's description of leaf color was a result of less than optimal cultivation in the cool damp English climate, and he also remarked that Verdoorn had failed to acknowledge Lindley's *β purpurea* with "rich purplish crimson" flowers. Lehmiller could not find any validity in Verdoorn's assertion that *C. forbesianum* was an illegitimate name; there was no rule in the International Code of Botanical Nomenclature (ICBN) corresponding to the violation cited by Verdoorn. Lehmiller provided a counter argument

based upon specific Articles in ICBN and concluded that Verdoorn had erred. Lehmiller declared *C. delagoense* to be an illegitimate name (superfluous) and published *C. forbesii* (Lindley) Schultz emended Herbert as the proper name for the subject species.

#### 15. Archer & Archer (1996): *Bothalia* 26:153

Archer & Archer supported Verdoorn's assertion that the Forbes bulbs could have represented more than one species. Archer & Archer remarked: "In fact Verdoorn correctly considered *C. forbesianum* Herb. as an illegitimate name and continued to reject *C. forbesii* as a *nomen confusum*. The synonyms mentioned under *C. delagoense* by Verdoorn (1973), *Amaryllis forbesii* var. *purpurea* Lindl. and *Crinum forbesianum* var. *punicea* should be regarded as *nomen incerta*. At least three species of *Crinum* occur in Mozambique that could well fit Lindley's and Herbert's descriptions. These are the very variable *C. macowanii* Baker, *C. delagoense* and *C. paludosum*." Archer & Archer also stated that the correct name for the transfer to the Genus *Crinum* should be *C. forbesii* (Lindley) Schult. & Schult. f.

#### 16. Lehmiller (1997): *Herbertii* 52:44-65

Lehmiller republished *Crinum forbesii* (Lindley) Schultes emended Herbert while again listing *C. delagoense* and *C. stuhlmannii* as synonyms, remarking that the illegitimacy of *C. delagoense* Verdoorn had been discussed previously (Lehmiller, 1992).

#### 17. Zimudzi, Archer, Kwembeya & Nordal (2006): *Kirkia* 18(2):151-168

These authors divided *Crinum stuhlmannii* Baker into two subspecies, subsp. *stuhlmannii* and subsp. *delagoense*; the separation was made on the basis of geographical distribution and segment width: segment width up to 1.8cm and confined to Kenya and Tanzania = subsp. *stuhlmannii*, and segment width >2cm and representing the southern subsp. *delagoense*. They listed *C. forbesianum* Herbert as *nomen illegitimum* and reiterated that *C. forbesii* was a *nomen incertum*.

### DISCUSSION

Verdoorn's (1962) justification for publishing *Crinum delagoense* was circuitous. Verdoorn declared *C. forbesianum* Herbert to be illegitimate: "According to the rules of nomenclature, a change in the form of a specific

name when transferred to another genus is illegitimate.” Verdoorn did not cite a particular Article(s) in the International Code of Botanical Nomenclature (ICBN) to support her contention. As Lehmiller (1992) pointed out, Herbert (1837) did not alter the basal or stem portion of the name, instead converting “forbesii” to its adjectival form “forbesianum” in order to specify that it was a species in his carefully explained nomenclature scheme -- whereas to write it in noun form “forbesii” would have indicated that it was a hybrid. Moreover, Herbert (1825) was the originator of *Crinum forbesii* in botanical literature, and Herbert’s (1837) subsequent treatment constituted an orthographic alteration of the Latinized epithet “forbesii”.

There was no issue of illegitimacy regarding Herbert’s naming of the subject species. The following Articles from ICBN (Vienna Code, 2006) support that *Crinum forbesianum* was not illegitimate **but instead should be corrected** to *Crinum forbesii*:

**Art. 32.7:** Names or epithets published with an improper Latin termination but otherwise in accordance with this Code are regarded as validly published; they are to be changed to accord ...

**Art. 60.1:** The original spelling of a name or epithet is to be retained, ...

**Art. 61.2:** For the purpose of this *Code*, orthographical variants are the various spelling, compounding, and inflectional forms of a name or its final epithet (including typographical errors), only one nomenclatural type being involved.

**Art. 61.4:** The orthographical variants of a name are to be corrected to the validly published form of the name. Whenever such a variant appears in print, it is to be treated as if it were printed in its correct form.

Neither Verdoorn (1962, 1973), Nordal (1977), Archer & Archer (1995), nor Zimudzi et al. (2006) ever referenced which specific Article(s) of ICBN formed the basis for Verdoorn to declare *Crinum forbesianum* Herbert a *nomen illegitimum*. **Just claiming that a botanical epithet is illegitimate does not make it so.** Such a determination must be justified and supported by the rules of the International Code of Botanical Nomenclature (ICBN).

The emended description of *Crinum forbesianum* provided by Herbert (1837) could not be refuted other than for the “glaucous” term, and here,

the latter was apparently a cultivation artifact (see below) because Baker reported the same observation at a later date in the same setting (London). Baker had no difficulty in recognizing his living bulb as Herbert's *C. forbesianum*, and Verdoorn (1962) freely acknowledged that the Monteiro specimen of Baker was her *C. delagoense*. Verdoorn could not argue effectively against Herbert's *C. forbesianum* other than to declare it an illegitimate name.

Regarding Verdoorn's criticism that Lindley's description did not fit the subject species and may have represented a different species – the respondent path splits into two different directions: 1) "If" the bulbs in Lindley's possession differed from Herbert's, then *Crinum forbesianum* Herbert would become an established entity by default when Verdoorn's reasoning was followed, because it then would have represented a different species and would no longer be illegitimate. No Article in ICBN prohibits there being two different species named *C. forbesii* and *C. forbesianum*. (**Rec. 23A.2** frowns on such a practice but does not prohibit it.); and 2) However, an explanation existed for Lindley's description: Forbes collected very large bulbs circa October, 1822 at Delagoa Bay; these necessitated drying and transportation by ship back to his sponsor, the Horticultural Society of London. Unfortunately Forbes died in 1824 while still in Africa. The date when the bulbs actually arrived in London and were planted was not specified, but it was probably sometime during late spring/early summer of 1823. Transplanting large dried (dormant) bulbs of this species in the opposite hemisphere would have been a difficult undertaking (personal experience, DJL), not to mention that the climate of London in the 1820s was cold and inhospitable. Lacking the long exposure to the sun and heat of their indigenous climate, these bulbs did not fare well and were soon lost to rotteness per Herbert's (1837) note. That Lindley described the leaves as narrow, weak and glaucous was not surprising, since the initial bulb bloomed prior to March 1824 (presumably in the fall of 1823 before winter). The bulb could not have acclimatized in such a brief period, and the blooming of a scape (formed during the pre-collection period) would have occurred during a suboptimal state. The blooming of the  $\beta$  *purpurea* variety was reported in the interval from March 1824 to March 1825, but this blooming must have occurred during the summer of 1824 because in 1825 Herbert reported that already he had obtained hybrids between *C. forbesii* and *C. careyanum*. Verdoorn (1962) assumed that Herbert actually

cultivated *C. forbesianum* in his “garden”; however, there was no evidence indicating that Herbert actually possessed a bulb. As Lehmiller (1992) noted, Lindley and Herbert were close personal friends and frequently shared botanical materials – that Herbert (1824) and Lindley (1825a) both utilized the same specific epithet “forbesii” in their initial publications implied that they had agreed to honor Forbes in the naming of this plant. The subject bulbs were the property of the Horticultural Society of London, Lindley’s employer. Lindley, having only been hired in 1822, likely did not have the authority to give Herbert a bulb of *C. forbesii*. Herbert though did not recount any measurements of the plant or flowering parts, which was most unusual for Herbert. Also, Herbert (1837) reported using only the pollen of *C. forbesianum* to attempt interspecific hybrids, while he did not allude to attempting hybrids with *C. forbesianum* as seed parent – again unusual for Herbert. So most likely Herbert never cultivated *C. forbesianum* in his greenhouse but rather observed it at the Horticultural Society’s facility. Neither Lindley nor Herbert mentioned the characteristic red fruit of this species (the species is prone to pseudocarp; personal observation, DJL), further suggesting a suboptimal adaptation during the initial recorded bloomings. Also, it was highly likely that the  $\beta$  varieties of Lindley and Herbert represented the same bulb; when Herbert Latinized his description for the  $\beta$  variety, he probably noted that Lindley had described the color as purplish-crimson but had named it  $\beta$  *purpurea* – hence, Herbert applied the obvious correction to  $\beta$  *punicea*. In conclusion, no evidence existed to support Verdoorn’s hypothesis that Lindley and Herbert examined and described different species.

Concerning Archer & Archer’s (1996) arguments that: 1) Verdoorn correctly regarded *Crinum forbesianum* as illegitimate -- this is not supported by the rules of ICBN and has been addressed above; and 2) Verdoorn intended *C. forbesii* to be a *nomen incertum* because Lindley’s original description could also have represented *C. macowanii* or *C. paludosum* – neither of the latter species is capable of producing umbels with 30-40 flowers as per Lindley’s original description. *Crinum macowanii* rarely produces as many as 26 flowers per umbel, and *C. paludosum* bears <15 flowers per umbel. *Crinum forbesii* is the only species within subgenus *Codonocrinum* capable of producing umbels of 30-40 flowers (the latter occurs episodically in mature bulbs within certain populations; the largest umbel observed by the author in a living bulb contained 37



flowers). Verdoorn (1962, 1973) referred to Lindley's description as many flowered, never once mentioning the 30-40 flowered umbels; ironically, under *C. delagoense*, Verdoorn listed the floral range as 10-30 flowers per umbel. *Crinum macowanii* distinctly exhibits undulate leaves, an additional important character which differentiates it from *Crinum forbesii* (see Fig. 5, 6) per Herbert's emended description.

Baker (1881) described the color of the leaves as "glaucous" although they were colored dull light-green in the illustration of Bot. Mag. t.6545 (Fig. 1). Again this color aberration may have resulted from suboptimal conditions, since the bulb was collected in 1877 at Delagoa Bay and flowered at Kew in 1878. In addition, a climate induced phenomenon related to low sunlight and cool temperatures may have contributed to the color. Per the on-line Encyclopaedia Britannica, the climate of London from 1875-1882 was characterized by harsh winters and cold springs.

The herbarium specimen (Stuhlmann **8536**, B; Fig. 4) which Baker (1898a) examined and utilized as the basis for *C. stuhlmannii* was far less than optimal – it was clearly borderline depauperate at best (opinion DJL), requiring an imagination to identify as no perianth tube was attached to the umbel, the only preserved intact flower was actually a flower bud with a straight perianth tube, and there was no leaf; it never should have been put forth as a new species. Baker described the flowers as erect (versus horizontal with curved perianth tubes for *C. forbesianum*), and he listed this species as #17a. within the *Crinum* scheme he published in Flora of Tropical Africa, which meant that Baker assigned it to his subgenus *Stenaster* -- and **not** to subgenus *Codonocrinum* wherein lay *C. forbesianum*. How could Baker have been so mistaken? Was Baker misled by the reference to "blue lotus water lily" on the herbarium sheet? Was it not ironic that Baker (1881) readily identified *C. forbesianum* in the living Monteiro specimen and associated herbarium specimen (Monteiro **53**, K; Fig. 1), but he could not recognize any similarity between the Stuhlmann **8536** herbarium specimen (Fig. 4) and *C. forbesianum*?

## CONCLUSIONS

Baker (1881) provided the appropriate solution to the lost Forbes bulbs and associated illustration, clarifying any uncertainty regarding the observations of Lindley and Herbert and the lost illustration. *Crinum forbesianum* Herbert stood unchallenged as the identity of the subject bulb

until Verdoorn (1962, 1973) expressed confusion to justify a renaming. Verdoorn's decision even went contrary to her mentor at Pretoria, R.A. Dyer (1937) who previously published an account of *C. forbesianum* Herbert including a field photograph. By not accepting Baker and by inappropriately declaring *C. forbesianum* Herbert to be an illegitimate name, Verdoorn was responsible for the ensuing taxonomic confusion – all subsequent publications purporting *C. delagoense* and *C. stuhlmannii* relied upon Verdoorn's accounts. Ironically, it was Baker (1898a) who was responsible for introducing *C. stuhlmannii*, an unwise decision based upon an inadequate herbarium specimen.

The ICBN rules specify that the specific epithet in *Crinum forbesianum* Herbert must be corrected to *Crinum forbesii*. In deciding upon the corrected botanical name with author credit, several factors merit consideration: 1) Herbert and Lindley collaborated on this plant, with Herbert (1825) originating the appropriate genus classification and specific epithet but Lindley (1826a) providing the initial valid publication; and 2) Herbert (1837) later provided an emended description that supplemented Lindley's brief description. It follows that the name, although unwieldy, which best honors both botanists should be *Crinum forbesii* Herb.ex Lindl. emend. Herb. Since no type materials including the illustration remain, it then follows that Baker's account establishes the appropriate topotype specimen and illustration, which are designated as such herein:

***Crinum forbesii* Herb. ex Lindl. emend. Herb., comb. & topotypus nov.**

*Crinum forbesii* Herbert (1825), Bot. Mag. t.2592., without description.

*Amaryllis forbesii* Lindley (1826), Trans. Hort. Soc. London p. 87, 285. No type specimen or drawing preserved.

**Emend.:** *Crinum forbesianum* Herbert (1837), Amaryllidaceae Pp. 260-267. No type specimen or drawing preserved.

*Crinum forbesianum*, Baker (1881), Bot. Mag. t.6545.

**Topotypus** (designated herein): **Mozambique.** Lebumbo Mountains, Delagoa Bay, October 1876, Monteiro 53, K (Fig. 3).

**Illustration** (designated herein): Bot. Mag. t.6545 (Fig. 1-2).

Syn.: *Crinum stuhlmannii*, Baker (1898a), Flora Trop. Africa, p. 578.

*Crinum delagoense*, Verdoorn (1962), Flow. Plants Africa t.1389.

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**Fig. 5.** *Crinum forbesii* displaying characteristic red fruit (seed pods), Outjo-Otavi Highway (C-39), Namibia, January 19, 1991. Photograph by the author.



**Fig. 6.** *Crinum forbesii* blooming in cultivation, Southeast Texas, May 8, 2009. Photograph by the author.

# NOTES ON *AMMOCHARIS* HERB. (AMARYLLIDACEAE) WITH PARTICULAR REFERENCE TO *AMMOCHARIS* *ANGOLENSIS* (BAKER) MILNE-REDH. & SCHWEICK.

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## INTRODUCTION

The African genus *Ammocharis* was established by William Herbert (1821) and currently has six species. It is distributed across a vast area of southern and Tropical Africa and represented in at least 17 countries, extending from the Cape Peninsula in the south-west of South Africa to the southern part of South Sudan. There are five summer-growing members, *A. angolensis* (Baker) Milne-Redh. & Schweick., *A. baumii* (Harms) Milne-Redh. & Schweick., *A. coranica* (Ker Gawl.) Herb., *A. nerinoides* (Baker) Lehmiller and *A. tinneana* (Kotschy & Peyr.) Milne-Redh. & Schweick., and a single winter-growing species, *A. longifolia* (L.) M.Roem. Of these, *A. angolensis* is perhaps the least well known to growers and taxonomists. Plants of this species flowered recently in the bulb collection at Kirstenbosch Botanical Garden, and here I augment the descriptions of Baker (1878) and Milne-Redhead & Schweickerdt (1939) and provide brief notes of all the species, with a key and remarks on cultivation.

Milne-Redhead and Schweickerdt (1939) have provided the most comprehensive taxonomic treatment of the genus thus far, but some of the names they recognized have passed into synonymy and the plant they described as *Cydistetes longifolia* (L.) Milne-Redh. & Schweick. has reverted to *Ammocharis*. The major morphological character distinguishing *Ammocharis* from closely related *Crinum* L. is leaf arrangement, which is biflabellate in *Ammocharis* (arranged in two opposite, spreading fans) and spiral or distichous in *Crinum*, yet this is sometimes difficult to distinguish in pressed material. The current taxonomic position of the plant previously known as *Crinum baumii*, now included in *Ammocharis*, is somewhat ambiguous, as certain individuals in cultivation at Kirstenbosch have spiral leaf arrangement, whereas others have distichous-biflabellate leaves. A

striking feature of *Ammocharis* and all species of southern African *Crinum* except *C. moorei* is that their outer leaves always have truncate apices. These older leaves die back to their bases at the start of the dormant period, but remain perennial just below the soil surface, growing out again at the onset of the following growth cycle; only the new leaves produced from the centre of the bulb have acute apices that subsequently die back and exhibit the truncate effect from the second growing season onwards. All *Ammocharis* species have solitary bulbs and only reproduce by seed. The genus takes its name from the Greek words *ammos* (sand) and *charis* (grace or beauty), alluding to the showy inflorescences, often encountered in sandy habitats.

### THE SUMMER-GROWING SPECIES

#### *Ammocharis angolensis*

*Ammocharis angolensis* was originally published as *Buphane angolensis* Baker in the Journal of Botany, based on a collection made by the Austrian medic, explorer and botanist Dr. Friedrich M.J. Welwitsch in the province of Huila, in the temperate south-western region of Angola (Baker 1878). The species was subsequently referred to *Crinum* by Bentham and published in Baker's Handbook of the Amaryllideae (1888) and finally transferred to *Ammocharis* in the Botanical Journal of the Linnean Society by Milne-Redhead & Schweickerdt (1939). The distribution of *A. angolensis* extends to Zambia and Uganda in Central Africa. Baker (1878) described the flowers as 'dull red', but his description was made from pressed material, and no doubt he was influenced by the prominent pinkish red midrib of the tepal lower surfaces. During a recent expedition to south-western Angola, one of my horticultural colleagues, Adam Harrower, collected two dormant bulbs of an unidentified amaryllid in the district of Humpata, not far from the type locality (*Harrower 4122*, in NBG). I cultivated them in the bulb nursery and when their leaves appeared, they were immediately recognizable as belonging to *Ammocharis*. One of them flowered in November 2010 and proved to be *A. angolensis*, and both bulbs flowered in November 2011, one of which produced two inflorescences. The perianth tubes of *A. angolensis* are extremely slender, possess plentiful nectar and have a musty-sweet scent that intensifies at night, probably signifying night pollination by hawk moths. The plants frequent fairly shallow, sandy soil overlaying laterite in seasonally flooded, open grassland (Milne-Redhead & Schweickerdt 1939).

The species is easily recognized by its purple-margined leaves, relatively short, strongly curved scape up to 40mm long, short pedicels up to 10mm long which do not elongate in fruit, its long, narrow perianth tubes 50-87mm long, its narrow, white tepals that become conduplicate with age, with a pinkish-red midrib on the lower surface, and in its relatively short filaments that are shortly exerted beyond the mouth of the tube. The flowers are relatively long-lived for an ammocharis, each lasting 6-7 days. The leaves are hysteroanthous, emerging directly after the flowers of the first inflorescence have opened (Fig. 1-5). According to Kwembeya et al. (2007), *A. angolensis* forms a sister relationship with *A. longifolia*. The flowering period extends from October to November.

**Typification:** *Ammocharis angolensis* (Baker) Milne-Redh. & Schweick., Journal of the Linnean Society (Botany) 52:186 (1939). *Buphane angolensis* Baker, Journal of Botany 16:197 (1878). *Crinum angolense* (Baker) Benth. ex Baker, Handbook of the Amaryllideae:80 (1888). Type: **Angola**. Huila, in bushy, dampish pastures near Mumpula and Lopollo, *F.M.J. Welwitsch* 4012 (BM!, holotype; K, isotype).

**Synonymy:** *Crinum curvifolium* Baker, in O. Warburg (ed), Kunene-Sambesi-Expedition:565 (1903). Type: Angola, Kuebe, Matunguë River, *H. Baum* 331 (B!, holotype; M, isotype).

*Ammocharis heterostyla* (Bullock) Milne-Redh. & Schweick., Journal of the Linnean Society (Botany) 52:184 (1939). *Crinum heterostylum* Bullock, Bulletin of Miscellaneous Information, Kew:505 (1932). Type: Uganda, Kabaroni, Mt. Elgon, *J.D. Snowden* 1055 (K!, holotype).

**Description:** *Deciduous, summer-growing geophyte* 120-240mm high. *Bulb* ovoid, 100-120 x 70-80mm; neck short, 10-20mm long; tunic multilayered, outer layers hard, dark brown; roots fleshy, perennial. *Leaves* 6-10, strap-shaped, 160-250 x 14-28mm, hysteroanthous, bilabellate, strongly curved, adpressed to ground or ascending, perennial, glaucous, striate; margins purple, minutely toothed. *Scape* stout, solid, aerial portion very short, 20-40 x 15mm, strongly curved, purple, emerging laterally. *Inflorescence* umbel-like, 6-16-flowered; spathe bracts 2, ovate, 40-60 x 10-20mm, papyraceous, translucent white, heavily purple-striate; bracteoles 10-12, filiform, 30-40 x 0.5mm, white; pedicels suberect, 3-10mm long, purplish brown. *Flowers* trumpet-shaped, musty-sweet scented, intensifying at night; perianth tube cylindrical, 50-87mm long, straight, extremely slender, light brownish pink, flaring slightly towards apex, containing plentiful



nectar; tepals narrowly lanceolate to oblanceolate, 30-45 x 3-6mm, widely flared, canaliculate, becoming conduplicate with age, upper surface white, lower surface white or pinkish-white with prominent pinkish-red midrib. *Stamens* slightly inwardly curved, filaments adnate to perianth tube for most of length; free portions shortly exerted beyond mouth of tube, 6-10mm long; anthers oblong, 3-4 x 1mm, basifixed. *Ovary* oblongoid, 10-14 x 3-5mm, pinkish-brown; ovules more or less globose, 6-8 per locule; style well included within tube, 40-56mm long, straight, white, tinged with light green, area just below stigma dark pink; stigma minute, capitate, translucent white. *Fruit* more or less globose, 15-25 x 10-20mm, membranous, indehiscent, rupturing irregularly. *Seed* more or less globose, 4-6 x 3-6mm, endosperm light green, 1-18 per fruit.

*Cultivation:* *Ammocharis angolensis* performs well in 30cm diam. deep plastic pots in a sandy growing medium, in full sun. At Kirstenbosch the bulbs are kept bone dry from autumn until early summer, at which time a heavy drench is applied. Once flowering has commenced and the leaves have started to emerge, a further heavy drench is applied, and continued throughout summer approximately every two weeks. The plant has moderate appeal in its long-tubed, scented white flowers, and intensely glaucous leaves with purple margins, but will probably be more of interest to the specialist collector of unusual geophytes than to generalist growers.

### ***Ammocharis baumii***

The dwarf *A. baumii* was originally described as *Crinum baumii* Harms from specimens collected by H. Baum along the Kubango River above Chirumbu in October 1899 in southern Angola, during an expedition to the Kunene-Sambesi region (Harms 1903). It was subsequently transferred to *Ammocharis* by Milne-Redhead and Schweickerdt (1939) in the Botanical Journal of the Linnean Society, but it was returned to *Crinum* by Dr. I.C. Verdoorn in her review of the genus (Verdoorn 1973). Following two recent molecular phylogenies of *Crinum* (Meerow et al. 2003; Kwembeya et al. 2007) it has been returned to *Ammocharis*. The opinion of Dr. David Lehmiller is that until more advanced DNA studies become available, and more taxa have been analysed, including intergeneric hybrids, this plant should either be retained within *Crinum*, or be treated as the sole member of a new genus (Lehmiller 2010). The species occurs as scattered, solitary individuals in deep white sand, and its range extends

to Botswana, Namibia and Zambia (Zimudzi et al. 2006). Flowering takes place from October to December.

**Cultivation:** *Ammocharis baumii* is rare in cultivation but performs well in 20cm diam. plastic pots, flowering reliably in sandy media, in full sun. The flowers are extremely short-lived, opening in the evening and lasting no more than two days. They create a striking, if ephemeral show when grown in groups (Fig. 6) and produce two to three inflorescences per bulb, at staggered intervals (Duncan, 2010). The bulbs require a sustained period of winter drought in order to ensure flowering the following summer and to prevent fungal rotting. Seedlings can flower in four years in ideal conditions, but up to six years may be required.

### ***Ammocharis coranica***

Originally described in 1816 as *Amaryllis coranica* by J.B. Ker Gawler in Edwards's Botanical Register, the species was transferred to *Ammocharis* by William Herbert five years later (Herbert 1821). The type collection is that of the naturalist William Burchell, made at Klipfontein in Griqualand West in central South Africa, and the Latinised specific name *coranica* pertains to the Korana Bushmen, a nomadic tribe of the arid interior of South Africa, where this species is common. Certainly the most familiar ammocharis to residents of southern Africa, tepal colour in *A. coranica* varies in shades of pink, or occasionally pinkish-red, and pure white forms occur rarely. The bulbs are tolerant of extreme drought and adapted to remain dormant for one or more growing seasons, and the leaves are mostly synanthous or occasionally hysteranthous. It is widespread from the eastern Little Karoo across the summer rainfall parts in all provinces of South Africa, extending to Botswana, Lesotho, Namibia, Swaziland, Zimbabwe and Angola, forming dense colonies on seasonally moist, stony, silty or alluvial flats and depressions (Fig. 7-9). It has a long flowering period from October to February.

**Cultivation:** *Ammocharis coranica* is the most commonly grown member of the genus and is suited to large, deep pots, and in temperate climates, to rock garden pockets, in full sun. Its sweet-scented, dense showy umbels are short-lived, but two to three inflorescences are often produced per bulb. In well drained media the bulbs are fairly tolerant of moisture during the winter dormant period but are best kept absolutely dry during this period. The plants readily remain evergreen in cultivation but fail to flower unless

forced into winter dormancy by sustained drought. In summer they thrive on heavy drenching at intervals of approximately two weeks. In ideal conditions, seedlings can flower in seven or eight years (Duncan 2010). In southern Africa, the leaves are highly susceptible to attack by the lily borer, *Brithys pancratii*.

### ***Ammocharis nerinoides***

*Ammocharis nerinoides* was originally described by J.G. Baker in Bulletin de L'Herbier Boissier from a single inflorescence collected in 1892 in the district of Gobabis in Hereroland, Eastern Namibia (Baker 1903). The later works of Milne-Redhead & Schweickerdt (1939) and Sölch (1969) suggested the species was probably best placed in *Ammocharis*, but as the type collection did not include any leaf material, it could not be assigned to that genus with certainty. Dr. I.C. Verdoorn recognized it under *Crinum* in her review, and she cited two additional collections from northern and eastern Namibia (Verdoorn 1973). In the summer of 1980, one of two bulbs in the bulb nursery at Kirstenbosch, labelled '*Nerine* sp.', collected north-east of Windhoek in 1963, flowered for the first time, and proved to be the species now known as *A. nerinoides* (Fig. 10). Having never been illustrated in colour before, a fine painting was executed by Ellaphie Ward-Hilhorst and published in Veld & Flora, the Journal of the Botanical Society of South Africa (Duncan, 1982). Research conducted in habitat by Dr. David Lehmiller and Dave Hardy afforded a detailed study of the plants, in which the presence of biflabellate leaves was confirmed, and the species was transferred to *Ammocharis* (Lehmiller 1992). The plants occur in large colonies in loamy-clay soil around seasonally inundated limestone pans, flowering opportunistically in rapid response to heavy rainstorms, and at a locality in Hereroland in eastern Namibia, it grows in association with the dwarf *Nerine pusilla* Dinter (Duncan 2005). The flowering period extends from November to January.

**Cultivation:** This dwarf, sweet-scented species adapts very well to cultivation, and at Kirstenbosch it performs admirably in 25cm diam. plastic pots, in a sandy-gritty medium, in full sun. The main flowering flush is in November, but additional inflorescences may appear at any time up until mid-January. As with *A. baumii* and all the summer-growing *Ammocharis* species, the bulbs are kept very dry in winter, and drenched at well-spaced intervals during summer. The plants readily set seed following

hand pollination, and grown in ideal conditions, seedlings have flowered in their fourth season at Kirstenbosch (Duncan 2003).

### ***Ammocharis tinneana***

*Ammocharis tinneana* was originally described as *Crinum tinneanum* by T. Kotschy and J. Peyritsch in *Plantes Tinnéennes* (1867), and transferred to *Ammocharis* by Milne-Redhead and Schweickerdt (1939). The type collection was made by A. Tinné in 1837 along the banks of the Bahr el Ghasal River, toward the towns of Dembo and Bono in what is now South Sudan. It has the widest range of all the *Ammocharis* species, occurring in Botswana and Namibia in the northern parts of southern Africa and over much of Tropical Africa, including Angola, the Democratic Republic of Congo, Zambia, Zimbabwe, Mozambique, Malawi, Tanzania, Uganda, Rwanda, Chad, Kenya, Ethiopia, Somalia and South Sudan. Plants usually occur in small colonies on flats in open deciduous woodland. Following heavy downpours, flowering occurs just prior to, or simultaneously with, the emergence of the leaves, from late spring to mid-summer, and tepals range in shades of pink, carmine or purplish red. Superficially similar to *A. coranica*, *A. tinneana* is set apart mainly by its much longer perianth tube (60-130mm, as opposed to 10-25mm in *A. coranica*), by its narrower tepals that are strongly spirally recurved towards the apex, and in its shorter pedicels. Flowering takes place from October to January.

Cultivation: This species is not very widely grown, but has exactly the same cultivation requirements as *A. coranica* (see above) (Fig. 11-12).

### **THE WINTER-GROWING SPECIES**

#### ***Ammocharis longifolia***

*Ammocharis longifolia* has the longest and most complicated history of all the species and was known at least as early as 1623, when J.P. Vallet, gardener to King Henry IV of France and Navarre, provided an outstanding etched plate of the plant in full flower, accompanied by the phrase name *Lilio Indicus pumilinet Autumnnalis flore Rubello* on page 24 of his tome *Le Jardin du Roy très chrestien Henry IV Roy de France et de Navare*, published in Paris in 1623, well over a century before Linnaeus first described it as *Amaryllis longifolia* L. in his *Species Plantarum* in 1753. The plant was subsequently referred to several genera including *Ammocharis* Herb., *Brunsvigia* Heist., *Crinum* and *Haemanthus* L., and in

1939, the new monotypic genus *Cybistetes* Milne-Redh. & Schweick. was created to accommodate it, based on its differences in fruit morphology from *Ammocharis* and closely related genera. Snijman & Williamson (1994) suggested that separation of *Ammocharis* and *Cybistetes* needed re-examination, and recent molecular phylogenetic studies (Meerow & Snijman 2001; Meerow et al. 2003; Kwembeya et al. 2007) showed the close relationship between *Cybistetes* and *Ammocharis*, and promoted the inclusion of *Cybistetes* within *Ammocharis*, yet the former possesses a number of striking morphological differences, already enumerated in detail by Lehmler (2007; 2010), which calls its inclusion in *Ammocharis* into serious doubt. Differences between *Cybistetes* and species traditionally included under *Ammocharis* include the widely funnel-shaped, zygomorphic flowers (actinomorphic and trumpet-shaped in *Ammocharis*), pedicels that elongate considerably following anthesis and become rigid (in *Ammocharis* they do not elongate and remain relatively soft), fusiform, six-ribbed fruits with papery walls (subglobose, globose or oblongoid in *Ammocharis*, with membranous walls that rapidly disintegrate) and seed dispersal effected by a wind-tumbled infructescence (as opposed to local dispersal in *Ammocharis*). It is interesting to note that *A. longifolia* only produces a solitary inflorescence per season whereas all the other members of this genus (*A. angolensis*, *A. baumii*, *A. coranica*, *A. nerinoides* and *A. tinneana*) frequently produce multiple inflorescences, at staggered intervals.

*Ammocharis longifolia* ranges from southern Namibia to the Cape Peninsula and inland to the western Little Karoo in South Africa, and occurs in large colonies on deep sandy, or relatively shallow sandy-gravel flats (Fig. 13-14). Forms occurring near Saldanha on the Cape west coast commence blooming in early December (Duncan 1977) and the flowering period extends to April.

Cultivation: This species is suited to large containers (30-35cm diam.) and dedicated rock garden pockets kept absolutely dry in summer. It performs well in sandy media in full sun, and containers have to be sufficiently deep to accommodate the large bulb, long neck and extensive fleshy roots. Unlike all other *Ammocharis* species, this plant flowers rather erratically in cultivation. In ideal conditions, small forms can flower in eight years from seed, but the larger forms take at least 10 years (Duncan 2010).

**KEY TO THE SPECIES OF *AMMOCHARIS***

- 1a.** Leaves 3mm broad or less; plants gracile ..... **2**
- 1b.** Leaves 14mm broad or more; plants robust ..... **3**
- 2a.** Leaves more or less erect, bright green, margins entire; perianth white, maturing to pink, tube 60-120mm long, tepals linear, 5mm broad; far north-eastern Namibia to Botswana, Angola, Zambia and Zimbabwe ..... ***A. baumii***
- 2b.** Leaves spreading, glaucous, margins toothed; perianth rose-pink, tube 10-25mm long, tepals lanceolate, 8-12 mm broad at widest point; eastern to northern Namibia ..... ***A. nerinoides***
- 3a.** Plants winter-growing; flowers widely funnel-shaped, tepals 8-14mm broad, apices slightly recurved; southern Namibia to Cape Peninsula and western Little Karoo in South Africa ..... ***A. longifolia***
- 3b.** Plants summer-growing; flowers narrowly trumpet-shaped, tepals 3-8mm broad, apices strongly recurved ..... **4**
- 4a.** Perianth tube 10-25mm long; widespread in southern Africa, extending to Angola and Zimbabwe ..... ***A. coranica***
- 4b.** Perianth tube 50-130mm long ..... **5**
- 5a.** Tepal upper surfaces white, perianth tube 50-87mm long; stamens 8-10mm long, just emerging beyond mouth of tube; pedicels 3-10mm long; Angola to Zambia and Uganda ..... ***A. angolensis***
- 5b.** Tepal upper surfaces pink, carmine or purplish red, perianth tube 60-130mm long; stamens 40-75mm long, well exerted beyond mouth of tube; pedicels 20-45mm long; widespread from Namibia to South Sudan ..... ***A. tinneana***



**Fig. 1.** *Ammocharis angolensis* in cultivation at Kirstenbosch. Photograph by Graham Duncan.



**Fig. 2.** *Ammocharis angolensis* in cultivation at Kirstenbosch. Photograph by Graham Duncan.



**Fig. 3.** *Ammocharis angolensis* in cultivation at Kirstenbosch. Photograph by Graham Duncan.



**Fig. 5.** *Ammocharis angolensis* fruits and seeds in cultivation at Kirstenbosch. Photograph by Graham Duncan.





**Fig. 4.** *Ammocharis angolensis* with opening buds and developing fruits in cultivation at Kirstenbosch. Photograph by Graham Duncan.



**Fig. 6.** *Ammocharis baumii* in cultivation at Kirstenbosch. Photograph by Graham Duncan.



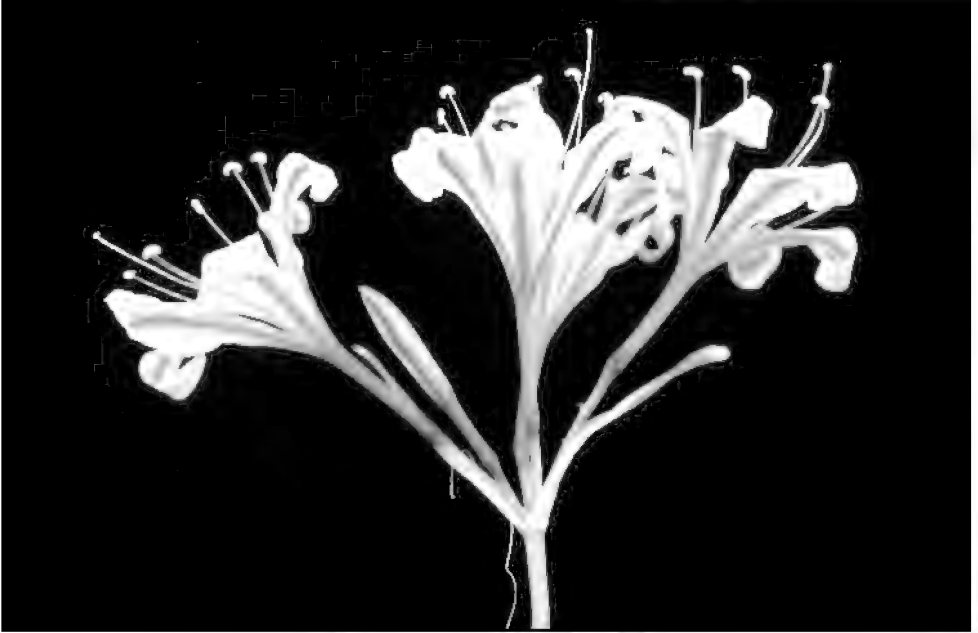
**Fig. 7.** *Ammocharis coranica* in habitat near Standerton in Mpumalanga, South Africa. Photograph by Graham Duncan.



**Fig. 8.** *Ammocharis coranica* in habitat near Cathcart in the Eastern Cape, South Africa. Photograph by Cameron McMaster.



**Fig. 9.** *Ammocharis coranica* in habitat near Tshipise in northern Limpopo, South Africa. Photograph by Laurian Brown.



**Fig. 10.** *Ammocharis nerinoides* in cultivation at Kirstenbosch. Photograph by Graham Duncan.



**Fig. 11.** *Ammocharis tinneana* in cultivation in Texas. Photograph by David Lehmill.



**Fig. 12.** *Ammocharis tinneana* in cultivation in Texas. Photograph by David Lehmiller.



**Fig. 13.** *Ammocharis longifolia* in habitat in deep sand near Saldanha, Western Cape, South Africa. Photograph by Graham Duncan.



**Fig. 14.** *Ammocharis longifolia* in habitat in sandy gravel near Melkbosstrand, Western Cape, South Africa. Photograph by Graham Duncan.

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## **LYCORIS – JEWELS AMONG THE AMARYLLIDS A GARDENER’S PERSPECTIVE**

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### **INTRODUCTION**

**Opening Comments and Scope.** Some people have described *Lycoris* as gorgeous, exotic, beautiful, stunning – but others have said they are unpredictable and capricious. They can be all of the first and mostly overcome in the second. The observations I make in this article are as a gardener and not a professional botanist. Consequently, this article is meant for those of us who grow these bulbs for pleasure and not for trying to describe them botanically. Needless to say, every gardener will need to be assiduous in study to make the most of what they have.

The genus *Lycoris* – a Greek word meaning “twilight” and/or named after the Roman actress and mistress of Mark Antony – is represented by 14 to 27 bulb species, and there are also varieties and forms. Some of them are among the most beautiful and exotic of the amaryllids. Indeed, they vie with some of the most beautiful flowers in the world and are horticultural jewels. Each to his own, of course, but their colors, forms, and time of bloom beg for garden use. In mid summer to early fall, most often after their planting area receives a deep soaking as if they were enjoying the deep rains brought by Asian typhoons that nature delivers to them in late summer and early autumn, the leafless bloom spikes rocket up from the soil, sometimes two to three inches overnight. The spikes reach maximum height within a week or so and then the blooms unfold. The flowers are in an umbel and last as long as 10 to 14 days, depending upon garden siting in sun or shade and whether the weather is hot, sunny, and dry ... or cool, cloudy, and humid. Heights vary from a dainty 9 inches (in.) for one species to a robust 30 in. and more for one or two of the largest species.

The scope of this article is limited because of bulbs available to me as well as the botanical complexity of the subject. Scientific botanical matters are best put into a footnoted article, so this article and accompanying pictures are aimed at garden growing *Lycoris*. My comments are based on some 40 years of my own observations mainly from my plantings in the

warmer part of Zone 7b, south of Memphis, Tennessee, USA. Oddly, many of the same observations hold fairly consistent to my experiences at home in Zone 10 of the San Fernando Valley of Los Angeles. In a few cases, I have extrapolated data from other careful observers to provide information not fully clarified by my own observations.

There is not to my knowledge one source that provides all the data on *Lycoris* that is available. I have had to take notes from many publications as well as resort to personal correspondence, websites, conversations, and my own observations to pull together everything I present here. I have tried very hard to bring much known information about *Lycoris* into this one article. Be aware, however, that while I have an extensive collection, I do not grow all species, varieties, forms, or hybrids; and I have chosen not to try to give information on those with which I am not familiar. Further, there seems to be some confusion among published reports by botanists regarding a few of the species, mainly the subtropical and tropical yellow ones. For a gardener such as I, this confusion simply cannot be clarified!

I will briefly cover the following subjects: botanical matters, confusion in nomenclature, general description, garden value, flower forms, leaf-emergence types, flower arrangements, palatability and poison, and various cultural considerations. I will show pictures of most of the species and wild forms in the general order of their bloom, after which I will discuss and depict selected modern hybrids in the order of their bloom. The pictures are exclusively from my own gardens. It is up to your gardening imagination to place the bulbs into an advantageous landscaped setting.

**Botanical Matters.** The genus *Lycoris* is in Family Amaryllidaceae. The word *Lycoris* is most properly pronounced “**like**’-o-riss” but is commonly pronounced “lie-**core**’-iss” in the USA. The center of distribution is China, and all are native to China, Japan, Korea, and nearby East Asia (Laos, Thailand, Viet Nam, Nepal, and perhaps very rarely if at all in Pakistan, Afghanistan, and Iran). They are true bulbs in that they each have a basal plate from which springs concentric bulb scales. In short, their bulbs are somewhat like onions or daffodils.

Bloom scapes are solid. Flowers are at the top of a bloom scape in an umbel. Flower forms are varied but all have six petals (sometimes called tepals in the literature). When the petals overlap each other, most gardeners say the flower is imbricate. However, “imbricate” botanically may have a more limited application for those attuned to botanical precision. Most,

if not all, “imbricate” *Lycoris* seem to have three outer petals somewhat enclosing three inner petals, all equidistantly placed to each other. Most, if not all, *Lycoris* that are “non-imbricate” or “open petaled” (gappy, where the tepals do not overlap or even touch each other) seem to have all six petals arising equidistantly and next to each other from the ovary.<sup>1</sup>

As the scapes elongate, the green bracts completely enclosing the immature flower umbel give way to the expanding flowers at a time closer to their opening. By the time the flowers expand, the bracts usually separate from the bundle of flowers and shrivel into thin brown tissue that is hardly, if at all, visible. When seed is produced, it is black, globose, and of varying sizes (Fig. 1, 2, & 3). Seed cannot be kept dry as it almost immediately desiccates into a useless husk.

In the past, there has been much misinformation and confusion regarding species, forms, varieties, and hybrids. But now, the genus is finally being sorted out, and we are most grateful for those who have worked so tediously with limited recognition in doing this great service.

Some authorities present a known hybrid with the “x” before the specific name (such as *L. x haywardii*); other authorities do not always place the “x” (such as *L. haywardii*). I have tried to follow the dominant practice, when known.

**Confusion in Nomenclature.** The botanical placements and affinities of many *Lycoris* are being determined. For example, consider the questions related to *L. aurea* (Dr. Hamilton Traub’s<sup>2</sup> *L. traubii*) and *L. africana* (Dr. Traub’s *L. aurea*). Which of these names is correct for exactly which *Lycoris* – and are some bulbs known under some of these names actually hybrids? Within the genus *Lycoris*, there are many problems having to do with correct botanical understanding of many species, varieties, and forms. As I am a gardener and not a plant scientist, I do not enter the fray; and I am happy to wait until qualified botanists fully unravel these difficulties. It is confusing, as there are naturally occurring wild hybrids. Furthermore, it would seem that in the marketplace there may be human-created hybrids that have accidentally masqueraded as species. Karyotype studies and molecular studies are invaluable for this genus. As more work is done in

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Footnote <sup>1</sup>: A good discussion of these naming issues may be found in [www.Wikipedia.org](http://www.Wikipedia.org) under “Aestivation (botany)”. Please refer there for more details if needed.

Footnote <sup>2</sup>: The late Dr. Hamilton Traub probably needs no introduction. His work with botanical issues of amaryllids and *Lycoris* during the late 1900’s was invaluable.

sorting out confusions, surely the *Lycoris* we know will find their correct botanical placements.

**General Description.** Leaf growth is made during the fall and winter, during which time the bulbs' locations are easily seen. The leaves dry off in late spring and then the bulbs wait, underground and with no leaves, until the appointed time for bloom arrives. Usually after a deep soaking – which simulates late summer rainfall from typhoons – the bloom scapes emerge from the soil without leaves and elongate, leaning a bit toward the sun. At the top of the scape is an umbel bearing as few as 3 flowers and as many as 10, based on the species and cultural factors. References in this article to the width of the umbel are based on measurements across the widest spread, point to point, of the stigmas. Scape height is from ground level to the pedicels. Bloom commences in early summer and various species and hybrids continue the show into October.

**Garden Value.** From the first *Lycoris* that shows until the last, their bloom period spans nearly four months. I have even had one species to bloom as early as late June. As summer and fall bloomers, they provide garden color during a time that is begging for floral color and interest. Because they all bloom on bare, leafless scapes, many gardeners like to grow them with a ground-cover, nestle them into pleasing nooks and crannies with other herbaceous plants, or place them as visual accents in light woodland. I have found, as have thousands of American Southerners, that some of them do well simply naturalized in lawns that need not be kept mowed to a golf course perfection. Furthermore, their pastel or saturated colors are not garish but give the impression of softer tones. They are found in the following colors: red, orange, yellow, cream, white, pink, lilac, dark rose, blue-tipped rose, salmon, peach, smoke, and many complicated blended shades of those colors. No black, green, or true blue *Lycoris* exists. Even so, I have one that is greenish and there are several that have dark blue tips or light blue-orchid tones!

Time of bloom, scape height, leaf emergence, flower color, and cultural considerations suggest where these are best placed in a garden.

**Flower Forms.** Basically, *Lycoris* have two flower forms: a funnel- or trumpet-shaped form (Fig. 4) and a spidery form (Fig. 5). Compared to the latter, the funnel-form *Lycoris* flowers have wider segments and some are fragrant. This form usually has the stigma and anthers inserted within the petal tips. Flowers can be imbricate or non-imbricate. The funnel-form

*Lycoris* are generally the hardier. *Lycoris squamigera* (the pink “Magic Lily”) is a well-known example of this form.

The spidery form *Lycoris* have less wide petal segments that reflex substantially and with the stigma and anthers usually exerted beyond the recurve of the segments. The petal segments are usually crisped, wavy, and undulate. The general appearance from a distance is that of an enormous, colorful spider. Flower forms are all non-imbricate. None of the spider-form *Lycoris* species is fragrant. *Lycoris radiata* var. *radiata* (the “Red Spider Lily”) is the best example of this form.

Some *Lycoris* and hybrids do not fall into either category, which certainly complicates matters. As noted above, references in this article to the width of the umbel are based on measurements across the widest spread, point to point, of the stigmas (or of the petals of those that have inserted stigmas).

**Leaf-emergence Types.** Some *Lycoris* have leaves that emerge either in the late summer to fall and stay green over winter; these dry off usually sometime in April and May. Others have leaves that emerge in mid to late winter, thus missing much of winter’s coldest weather; these usually dry off a bit later than the fall-leaved ones. Leaf emergence, therefore, is a clue as to the hardiness of most *Lycoris*. Fall-leaved *Lycoris* are usually spider-form and generally more adapted to southern areas such as USDA Climate Zones 7, 8, and 9; mid- to late-leaved *Lycoris* are usually funnel-form and generally more adapted to northerly areas, such as Zones 7, 6, and 5.

**Use in Arrangements.** Using *Lycoris* scapes for flower arrangements is a relatively personal expression, as it is art. Yet I have seen several examples that were award winning. A few suggestions, however, might suffice as guides that cross all borders of choice. The spidery form *Lycoris* are visually commanding and come in many colors. Consequently, it is thought that similar competing forms and colors of other flowers in one arrangement or bouquet may be busy or confusing. Suggestion: do not overload a *Lycoris* bouquet with other flowers – instead use greenery, bare branches, or decorative grass to set off or frame the *Lycoris* as the central focus. The trumpet-form *Lycoris* in their relative simplicity, however, are somewhat easier to combine with other things in a bouquet.

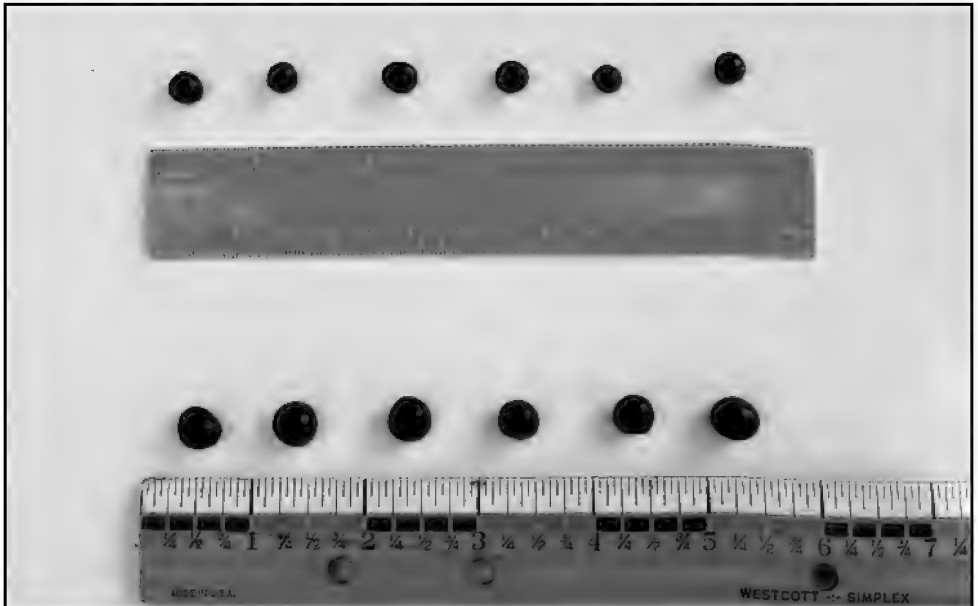
All *Lycoris* in a watered bouquet last about a week if picked in the morning at the beginning of their bloom and put quickly into cool water. Indeed, most *Lycoris* wilt quickly if not kept in water. Use of a flower



**Fig. 1.** Immature seed capsules (fruit) of *Lycoris*.



**Fig. 2.** Mature seed capsules (fruit) of *Lycoris*.



**Fig. 3.** *Lycoris* seeds.



**Fig. 4.** Funnel- or trumpet-shaped floral form of *Lycoris*.



**Fig. 5.** Spidery floral form of *Lycoris*.

preservative or even a dissolved aspirin in the water is beneficial and extends freshness. Keeping the scapes plunged into deep ice water and in a floral chiller until needed has also proven helpful.

**Palatability and Poison.** Bulbs of all *Lycoris* species contain the alkaloid poison, lycorine, which causes vomiting, diarrhea, convulsions, and sometimes death in humans and other animals. Although *Lycoris* bulbs are considered to have low toxicity, homeowners should be aware of the poisonous potential of them, especially if small children and pets are present. On the other hand, this poisonous component has the benefit of making them resistant to damage from deer and rodents. The Japanese exploited this poisonous aspect of *Lycoris* species by planting them along the edges of rice paddies, presumably to discourage rodents.

Another alkaloid component is galantamine, which is used in medications to treat Alzheimer's-type dementia. *Lycoris* is reported as being grown in plantations in China for mass harvest to extract this compound.

#### CULTURAL CONSIDERATIONS

**Hardiness and Heat.** *Lycoris* are native to Korea, Japan, China, Taiwan, and southward to north Myanmar (formerly, Burma). Korea has cold, snowy winters and hot, dry summers. The southernmost known species comes from a subtropical or tropical area that receives an average of 100 in. of rain a year. Thus, various species have varied climatic and hardiness preferences.

References in this article to climate zones are to the well-known United States Department of Agriculture Climate Zone Tables and Maps, which give average lowest winter temperatures by zone in degrees Fahrenheit. USDA Zone 4 ranges from -30° to -20°F; Zone 5 ranges from -20° to -10°F; Zone 6, from -10° to 0°F; Zone 7b, from 0° to 10°F; Zone 8, from 10° to 20°F; Zone 9, from 20° to 30°F; etc.. Each zone is further subdivided into the colder half denoted by an “a” and a warmer half denoted by a “b”. In the USA winter lows are capricious and sometimes can go much lower than the averages. For example, the city of Memphis, Tennessee, is located in Zone 7b, yet the all-time coldest-recorded winter temperature was in 1963: -13°F.

Most *Lycoris* seem to do well in Zone 8, but various species and hybrids can withstand occasional winter cold periods that are lower. Considerable cold scorching of exposed leaves will almost always curtail next bloom; however, given a more equable winter the bulbs will recover within another



year or two to blooming strength. *Lycoris* rated to a certain climate zone can often be grown in a colder zone provided the bulbs are sited in a warm pocket such as at the base of a south-facing wall or a heat source in the ground. Unheated cold frames have often proved helpful in obtaining bloom from *Lycoris* that otherwise would easily have been frozen.

As mentioned, leaf emergence plays an important part in how cold hardy any particular species or hybrid will be. This is not an invariable rule but is generally useful. It is likely that *L. squamigera* is one of the hardiest; I have seen it blooming in late August in West Yellowstone, Montana, where winter temperatures regularly go as low as -40°F, although always with a deep winter snow cover. *Lycoris africana* is the most tender; it does not usually succeed in an outside planting colder than USDA Zones 8 or 9. Cold hardiness of most *Lycoris* is simply not well reported in the literature; if reported commercially, it is often not carefully correct and is exaggerated to encourage more customers.

Much too little has been reported of the reverse of hardiness, i.e., how far into warm climates they can be expected to perform. So here are a few observations and guidelines. Most fall-leaved *Lycoris* will do well as far south as through USDA Zone 9 but do not do as well in more subtropical areas. Most winter-leaved *Lycoris* will do well through USDA Zone 7b but produce less and less bloom as one goes warmer from there. Such species as *L. squamigera* and *L. sprengeri* produce fewer blooms in mid-Zone 8 and warmer, although they both may produce abundant foliage and also may reproduce themselves into many bulbs.

As for summer heat, the summers of 2010 and 2011 were particularly hot and dry in the Mid-South, and the *Lycoris* bloomed better than they had ever bloomed before. It is likely that *Lycoris* bloom is prompted by summer heat. It should be made clear, however, that the heat and drought conditions favorable to *Amaryllis belladonna*, *Brunsvigia*, and other drought tolerant bulbs are not conducive to *Lycoris* health and bloom. Succinctly, dry and desert climates are bad for *Lycoris*, which may require artificial watering so that the roots always remain healthy and active in slightly moist soil.

**Soil Types and Chemical Reaction.** It is probable that all *Lycoris* prefer deep, silty loams with some admixture of humus, especially in the top layer of the soil. While they will persist and give some bloom in either sand or heavy soils, such is not their preference. *Lycoris africana* may, perhaps, prefer

sandy soils; but in St. Augustine, Florida, where this species grows so well, the soils usually contain copious amounts of decomposing shell and humus.

As for the chemical reaction of soil, with one or two exceptions that are covered later, *Lycoris* prefer a neutral to slightly acid soil. Many will grow and bloom well in slightly alkaline soil reactions, but that speaks more for their tolerances than for their preferences. In the American Southeast, where almost all species of *Lycoris* grow well, thousands of the red spider lily grow equally well under oak trees, whose decomposing leaves create acid soil conditions, and under pecan trees, whose decomposing leaves create alkaline soil conditions.

**Site Location and Placement.** Once preferred climate and soil conditions are determined for the species and hybrids you want to plant, you can then site your plantings within the garden in the most favorable spots. Generally, sunshine until noon or mid-afternoon with high, light shade thereafter seems to the liking of most *Lycoris* species both in non-desert California with little frost as well as other areas. In colder climates with less summer baking, the bulbs will prosper in borders that receive sunshine most of the day, particularly if they have a noninvasive ground cover to help keep the soil cooler and moister. In the American Southeast the bulbs do well in sunny places as well as in high, light shade, but with some moisture at all times. They are rarely seen flowering well in heavily shaded areas unless the area has abundant sunshine during the leaf growth period.

Often it is possible to give micro-climate conditions to a plant to help it feel more in its native environment. For those *Lycoris* that need warm winters, place them against the south facing wall of a house or other heated structure. For those that need chilly winters to initiate good bloom, plant them in the north shade of a building so there is little winter warming from the sun.

Certain conditions are rather conclusive. Almost all *Lycoris* are happiest where there is abundant sun during the period they have leaves. They are thus found in the margins of forest and field as well as in deciduous forests. While some may be found where there is considerable shade, it is usually true that they are merely surviving there; give them sun and light and the performance will be better. The bulbs are also happier where there is light herbaceous growth over them during the summer; this tends to keep the soil just a bit cooler and moister.

**Moisture Requirements.** Most *Lycoris* prefer fairly abundant and

constant soil moisture but coupled with good vertical and horizontal drainage. None happily tolerates deserts or bogs. *Lycoris incarnata* seems to require some summer drought to prompt bloom, as it comes from a part of China that has hot, dry summers as well as Korea. *Lycoris africana* prefers 80 to 120 in. of rain a year! All *Lycoris* naturally have live roots throughout the year when happily growing.

As previously mentioned, *Lycoris* naturally occur in eastern Asia where Pacific typhoons occur from July through October. It is understandable that their evolutionary adaptation for reproduction corresponds with the heavy rains they experience in late summer and fall. This is an important clue in obtaining good bloom. Obviously we cannot conjure up the heavy rains of a typhoon or hurricane – but we can always artificially water them. Even if one has only one clump, one can place a modestly dripping hose over them for the night.

**Planting Time and Depth.** Although *Lycoris* can be planted or transplanted at nearly any time except during cold or frosty weather, the best time to plant or transplant is after the leaves have dried off in the spring and before bloom is due. No *Lycoris* is known to dry off its roots as daffodils do; they keep live, white roots year-round. These live roots should be carefully preserved and the plant watered into its new location even if the bulb is without leaves.

As for planting depth, the spring-leaved *Lycoris* may be planted with about 1 to 2 in. of soil from the top of the neck to ground level. The fall-leaved *Lycoris* prefer slightly shallower planting. Experience suggests that almost no *Lycoris* prefers planting with more than 3 in. of soil above its shoulder, except perhaps in especially light soil. When *Lycoris* have happily situated themselves to the correct soil level, one often sees the noses just showing at ground level. If you do not know how deeply to plant, then put the bulb so that the very tip of the bulb is just at ground level. In good soils the contractile roots of *Lycoris* will slowly pull the bulbs deeper if planted too shallowly. If you plant too deeply, then several species and hybrids will form another bulb directly above the older and deeper one via a vertical elongation of the root plate (Fig. 6). This attempt to put itself higher into the soil certainly does no good to the overall health of the bulb and retards both bloom and multiplication. Plant correctly to avoid the problem.

In transplanting *Lycoris*, if heavily watered into place, the bulb sometimes can acquire a slight moist deterioration within the nose. This

probable bacterial infection can easily be avoided. When transplanting dry bulbs (without roots) be careful about watering until the bulbs have had a chance to produce vigorous new roots. If you transplant during bloom time, cut the bloom scape three to four inches above the nose and let it protrude above the ground; I have found this to prevent nose and bulb deterioration in every case. The remaining bit of scape will gradually dry off as the days and weeks proceed, and the bulb will reestablish perfectly.

If you dig and transplant bulbs, be careful not to spear or cut the bulbs. If you do, carefully clean the damaged bulb and dry it in shade until the wound has suberized. When you plant the bulb into its chosen location, keep excess water away until you are confident it will not begin to rot.

**Fertilizing.** *Lycoris* respond well to average garden fertilizing, but nitrogenous fertilizers should generally be avoided or applied only very lightly in late winter or early spring. Calcium nitrate is preferred over ammonium nitrate, which can cause bulb rot due to *Rhizoctonia* preferring it as a food! A general chemical fertilizer such as 5-10-10 lightly applied and watered in is beneficial. Very old cow manure is also good if lightly applied as a top dressing in late fall or early winter. Hardly anything is better than well rotted leaf compost, which can be used in great amounts both as a top dressing as well as a soil amendment. Some of the best bloom I have ever obtained was two to three years after putting a top dressing of potash around the bulbs. Bulbs generally like potash, and *Lycoris* do too.

**Renewal Planting.** Most *Lycoris* can stay put for many years. There are two clues to overcrowding: (1) less flower production when no other factor can account for it; and (2) bulbs lying on the surface of the ground all packed tightly together. In the latter case, red spider lilies will often multiply to the point that the bulbs are pushed onto the surface of the ground. Some of these bulbs will even come out of the clump and be subject to “death by lawnmower” or “death by trampling”. Oddly, even winter temperatures near 0°F seem not to hurt such completely exposed bulbs, even when the leaves are badly burned due to cold. Obviously, such bulbs do not bloom well and should be replanted appropriately.

**Diseases and Insects.** Dare I say that there are none! Well, I know of one report that complained of a greater bulb fly infestation. About ten years ago, I had one bulb infested by lesser bulb flies. Other than that, as far as I can determine, they are free of serious insect infestations as well as fungi and viruses.

During bloom time, at least one species of butterfly – a member of the skipper family – finds the flowers and more succulent parts of the umbel to be good caterpillar food. Also, sweat bees relish the pollen and some years will strip the anthers by mid-morning. During August through October, butterfly caterpillars, cutworms, and grasshoppers sometime predate the ripening seed (Fig. 7).

As the bulbs themselves have a poisonous alkaloid, livestock do not find them very palatable. If the soil is too waterlogged, then the bulbs can rot, and it would seem that *Rhizoctonia* is the culprit. However, good vertical and horizontal drainage in well-prepared soils – with the addition if necessary of sand or perlite – should obviate such a problem. All in all, good garden culture will avoid these problems.

**Flowering Frustrations.** To flower *Lycoris* regularly can be a challenge! Even when one has a mature and well-settled bulb, when cultural conditions seem perfect, when the leaf-growing period seems to have been lush and complete, and when there is abundant soil moisture, *Lycoris* may not put forth the show so eagerly anticipated. Recently the summer in the American Mid-South was unusually hot and dry, conditions not thought to be conducive to good *Lycoris* bloom. Yet, after a good flooding from the hose, most *Lycoris* put forth the best bloom ever. And in another summer, July and August both had quite abundant rainfall – and again there was excellent August bloom. This flowering frustration has been encountered by others, and I repeat it with consternation. Obviously, there is a confluence of factors that are still not fully understood. It could even be that a given *Lycoris* bulb may not bloom every year even when perfectly grown!

It seems that the single, most important factor promoting good bloom is abundant soil moisture near bloom time – either from rains or from artificial watering. Good leaf growth during the winter is also a factor. Apparently even summer heat has a part in the process. And the last observation, although unproven and unclear, is that cooler soil temperatures in late summer and early fall probably add to the equation at least in part or in some species.

An interesting case in point involves friends in Little Rock, Arkansas. From just three or four bulbs of *L. x houdyshelii* provided to them about six years ago, the clump has now reached 17 bulbs. August, 2010, after some 75 days of the hottest weather on record, saw 14 scapes in glorious bloom – but after the clump was given a long, slow soak from the water

hose! August, 2011, saw even more bloom.

All of these factors are enough of a challenge; but all of them can be overcome, ameliorated, or enhanced. One factor, however, cannot. It seems that when a *Lycoris* bulb blooms, that bulb often (but not always) will split into two smaller noses or bulbs as part of its normal multiplying. It may then take another year or two for these smaller bulbs to grow to blooming-sized maturity. Any expanding clump of bulbs may thus have some mature bulbs that bloom and a number of younger bulbs that are playing catch-up. Not every bulb of every size in a clump will bloom every year. This likely holds true for most bulbs!

One other interesting note: it may not be best to flood *Lycoris* before the preferred time of bloom. I have noticed that when a bulb is “forced” to bloom early by giving abundant water, the flowers often do not open together but are staggered. The best practice, then, is to wait until bloom should begin and then give them water.

In this article I have given usual bloom times. This, however, is not always exactly timely. Specific garden growing conditions may significantly alter the bloom dates.

**Pot Growing.** The only *Lycoris* that seems to take well to pot growing is *L. africana* (the St. Augustine, Florida, species described later) (Fig. 8). The literature has many reports that *Lycoris* can be grown in pots, and I have no doubt that assiduously attentive gardeners can, but they really do better in the ground. This probably has to do with cooler soil temperatures and a properly balanced distribution of moisture. If one has a rare *Lycoris* of unknown cultural needs, careful pot growing may be advised. But once this is sorted out, I suggest a good site in the ground.

Starting *Lycoris* seed in a pot is also sometimes convenient. However, once these youngsters have attained a year or two of good growth, moving them into a permanent location in the garden is advisable. If this is your procedure, be advised that young *Lycoris* seedlings are often unusually cold sensitive and can be killed when the mature bulbs would fare perfectly well.

**Hybridizing and the Future.** Complicated details of this subject are



**Fig. 6.** *Lycoris* bulbs originally planted too deeply that are in the process of moving upward via a vertical displacement of the root plate.



**Fig. 7.** Butterfly caterpillar feasting upon *Lycoris* petals.



**Fig. 8.** *Lycoris africana*.



beyond the scope of what can be presented here. Suffice it to say that the diploid species all intercross well. Surprisingly, even some of the non-diploids – if worked long and carefully – will produce a few seed. The Japanese and others are doing fine work in sorting out ploidy, but there is still room for anyone to experiment with hybridizing and to produce good results. Long known for being unbelievably slow to grow from seed to bloom – sometimes taking 15 years to bloom – there is information on how to grow the bulbs to bloom in just two or three years.

Once the flower has expanded, the appropriate pollen can be put onto the stigma and a string tag looped around the flowers with the parents written in indelible ink. Much has been written about removing anthers before dehiscing so that errant pollen cannot land onto the stigma. I have found in years of practice that such a necessity in *Lycoris* may be overemphasized. If one “loads” (thoroughly covers) the chosen pollen onto the stigma, there is little room for errant pollen grains to attach to the stigma. In growing many hybrids from seed, only a very few times have I found chance pollinations. The more aggravating problem is that sweat bees will sometimes vigorously take the pollen – both from the anthers and the stigma. Consequently, I often will pollinate twice. These little beasts seem especially drawn to *L. sprengeri*, whose flowers prove irresistible to their attentions.

Chance pollinations, however, commonly occur with *L. radiata* var. *pumila*, *L. x haywardii*, and with the “ra-hay” hybrids (*L. radiata* var. *pumila* x *L. x haywardii*), all of which easily make seed without human attentions. I have cut off the just-spent flower scapes of *L. radiata* var. *pumila*, laid them on the ground in a shady spot, covered them with loose plant matter, and they still produced copious good seed (albeit smaller than had the scapes been left to mature on the bulbs). *Lycoris x jacksoniana* is moderately fertile without human attempt. Other species usually need hand pollination to accomplish more than sparse seed. Some other hybrids are fertile with or without attempt, and it is likely that wind is the major vector.

Besides wind, other pollination vectors are European (Italian) honey bees and butterflies. Often when honey bees are driven by the lack of easy nectar, they will be seen on *Lycoris* blooms, particularly the fragrant trumpet-formed ones. The bees, however, usually climb past the open anthers and directly into the heart of the flower. As for butterflies, several species are often seen taking nectar. A common visiting species seen both

in the Mid-South and in Los Angeles are members of the “Skippers”. In September the red spider lilies seem irresistible to members of the Sulphur family. The bright yellow butterflies flitting around and landing upon the bright red spider lilies is, indeed, a particularly moving and spirited advantage of growing and blooming them. During early evening an occasional moth may sometimes be seen.

Note that in this article there will be an occasional use of an abbreviation for “Open Pollinated”. While there does not appear to be a botanical requirement of how presented, many writers simply use the acronym “OP” behind the name. For example, *L. sprengeri* OP is read “*Lycoris sprengeri* Open Pollinated”, meaning that the pollen parent that produced the seed is unknown.

As for the future of hybridizing, most species have now been intercrossed and the results ascertained. There are, however, some species that surely have not been well and thoroughly worked. Quickly coming to mind is *L. sanguinea* used with almost any other mate. One might create a whole race of small or miniature hybrids out of the progeny of this diminutive *Lycoris* – and in various colors. Another important cross, which I think has not commonly been made, is *L. sprengeri* crossed with *L. chinensis*. The progeny would surely be as exceptionally winter hardy as the parents and extend its growing area. Yet another area to explore would be *L. longituba* and such mates as *L. straminea*, *L. shaanxiensis*, and *L. aurea*. There may be other interesting species crosses that beg for the hybridizers’ attentions.

Because there are now many interspecific crosses, perhaps the time has come to engage in more advanced hybridizing. For example, once the species of *Hippeastrum*, *Hemerocallis*, *Iris*, *Narcissus*, and other families had been crossed among their species, hybridizers then turned to selecting the hybrids for certain traits and hybridizing to enhance them. Some *Lycoris* hybrids have outstanding blue petal tips (inherited from *L. sprengeri*). Intercrossing the bluest of these hybrids might produce a flower entirely of an incredible electric blue. The various yellow *Lycoris* are large flowers; selections chosen to diminish the flowers and scapes might produce a race of miniature yellow *Lycoris*. In fact, I bloomed for the first time in August, 2011, a *L. chinensis* grown from seed that is just 60% to 65% of the usual size. I have dubbed this particular plant ‘Mini’ and it could likely produce a race of small to miniature hybrids that have winter hardiness. A few coral colored flowers similar to *L. radiata* var. *pumila* but with more tailored

petals are now appearing. No black *Lycoris* exists, but some intercrossed dark rose hybrids might edge us closer to the goal. Large flowered, tailored flowers, such as found in *L. longituba*, but with a true red color or an intense gold-yellow color would be outstanding. Even producing *Lycoris* that bloom without fail would be a great advance; this would probably entail using *L. radiata* var. *pumila*, *L. x haywardii*, and *L. x jacksoniana*, all of which are exceptional bloomers. And there are other directions that astute hybridizers might pursue. The field is open as so little of this more advanced work has been done. *Lycoris* hybridizing today is where *Hippeastrum*, *Hemerocallis*, *Iris*, and *Narcissus* hybridizing began more than 100 years ago; there is a lot of catching up to do!

I have produced a hybrid *Lycoris* that encompasses all that a fine hybrid should have. It is easily hardy in Zone 7b. It has a surpassingly beautiful pink flower a bit reminiscent of a half-sized *L. squamigera*; it is only 18 in. tall. It is quite predictable of bloom, always coming in late August. It blooms even when lacking in abundant soil moisture. And it is a good multiplier. This hybrid came from *L. x haywardii* and a pink “ra-hay” hybrid (*L. radiata* var. *pumila* x *L. x haywardii*). It is, thus, 75% *L. x haywardii* and 25% *L. radiata* var. *pumila*, both each clearly imparting their best strengths. Superior presentation and admirable plant habits should be some of the most important goals in anyone’s hybridizing within the genus.

There is a final consideration: as most *Lycoris* under usual culture take years to grow from seed to bloom, the ideal hybridizer is someone who is only 25 years old! If one starts hybridizing at age 65, one would be 75 before most of the seedlings would be blooming. And some seedlings would be even further away in blooming. This, however, should not really discourage an avid plantsman. There is the old story about a fellow who told his psychiatrist friend that he was avoiding pursuing medical school as he was already 65 and the pursuit of studies would take at least five to eight years. The psychiatrist alerted his fearful friend with a simple question: and how old will you be in five to eight years if you do not proceed!

**Propagation and Tissue Culture.** Almost all *Lycoris* will multiply naturally by forming offsets. Some species and hybrids are prolific of increase. But some are agonizingly slow. For example, I have grown *L. “sperryi”* (not an official name and probably a form of *L. chinensis*), and the several in my collection have multiplied from one bulb to two in 30 years. One *L. “sperryi”*, however, is tagged “Fast Propagator”, and it has

made five modest bulbs in the same period – still rather slow. *Lycoris radiata* var. *radiata* and var. *pumila* both multiply with speed, and one will be hard put keeping up with their increase! But if space and energy allow, can one really have too many? Some old Southern gardens in America have drifts of thousands of the heirloom red spider lily, and the sight during bloom time is always thrilling to see because of the mass of color and sheer numbers of flowers.

For diploid *Lycoris*, seed can be planted, protected through the coldest part of winter, and will eventually make flowering sized bulbs. For triploid or other genetically complicated *Lycoris*, bulb multiplication is available. If faster increase is desired, the bulbs can be subjected to cuttage techniques. Tissue culturing *Lycoris* is another avenue that can be explored. Once superior cultivars have been identified, they should be propagated and disseminated to the widest possible audience. Natural increase of some *Lycoris* is simply far too slow to rely upon.

Yet another method of growing up seed has been found successful. Using this technique, seedlings can be induced to keep growing to a blooming size in just two or so years. Plant the seed on top of slightly moist, sterile, shredded peat moss. Keep the seed in moist warmth and sunlight. When the seed sends down the radicle (root) and small leaves are produced, keep the tiny bulbs pulled to the surface of the growing medium; do not let the little bulblets pull themselves down and out of sight. Light, liquid fertilizing is, of course, necessary as is keeping them out of freezing temperatures. As the leaves grow, some will start yellowing-off; immediately cut off the yellowed part of the leaf. By keeping the bulblets at the surface and the yellowing leaves removed, the plants will grow continuously to a mature size. At this time, adjust them into a normal cycle of seasons. Bloom will ensue after the next rest period. While this is most tedious, it nonetheless works. With thanks to Margo Williams who wrote me many years ago of this technique she used in the U.S. Department of Agriculture *Lycoris* experiments she managed. More details than this are beyond the scope of this article.

#### **LYCORIS SPECIES, WILD VARIETIES, AND FORMS**

The following listing of species and wild forms is given in bloom sequence based on the date the first open bloom was generally observed. Precociously early bloom, however, has been ignored as it is atypical. Due

to exposure, growing periods, moisture content of the soil, temperatures, and other factors, bloom can begin almost a month later in some and thus alter the sequence. Also, nature hardly ever puts all of her eggs into one basket: any particular species will always have individuals that bloom earlier or later than the majority. Data for the following species have been gathered over a period of several to 35 years.

Bloom dates are based on observations in USDA Zone 7b, south of Memphis, Tennessee, and in other cases in the San Fernando Valley part of Los Angeles, USDA Zone 10. Oddly, many *Lycoris* bloom at almost the same times in both locales, while others have significantly different dates of first bloom. Specific garden conditions may also alter bloom dates.

All images (except two) are from the author's gardens. Most recent images have been made with a Nikon D60 digital camera, rated at 10.2 megapixels. No color alterations have been made to natural flower colors. Some extraneous or obtrusive elements such as standards or sticks may have been photo-shopped out of some images.

Occasionally, when flower color is unusual – and *Lycoris* colors are often complex blends – or when there is no commonly accepted name for the color, I have used the color name best keyed to Pantone (The Pantone Book of Color, copyright by Pantone 1990, and published by Harry N. Abrams, New York). I have found this to be the best, low cost guide to color standards, and there are more than 1000 color chips with an ease of use. Where I have rarely used a Pantone color name, I have put a “P” within parentheses: (P). While cumbersome, it is sometimes more exacting; I have done my best to make color descriptions both simple and accurate.

Scape height is the measurement made from the ground to the beginning of the pedicels that hold the umbel of flowers. Garden presentation of the flowers is thus always slightly higher than the scape height. Umbel diameter is the measurement of the filaments, point to opposite point, or of the widest part of the flower petals in those specimens that have inserted flower parts.

***Lycoris sanguinea* var. *sanguinea*** (Fig. 9). Sparsely wooded areas of Japan, Korea, and China. This charming little 7 to 11 in. plant starts blooming as early as late June or a few days before, or simultaneously with, *L. squamigera*. It has flowers variously described as apricot to reddish-orange, orange-red, burnt orange, or jasper red. As the flowers bleach badly in the sun, it is best sited to receive considerable protective shade during its

bloom period. The small bulbs push up narrow leaves usually in the second or third week of February. It is hardy at least into Zone 6 and probably well into Zone 5. The dainty, trumpet-form 3 to 5 flowers are in 5.5 in. umbels. No fragrance. After heavy watering, sporadic scapes can push up as late as two months after the first major bloom period. It is a fertile diploid, easily seeds, and seems to have a slightly higher moisture requirement than many. While it has proved of fair culture in Zone 7b, I have had nothing but failure when trying to grow it in Zone 10. I believe it needs colder winters such as found in its native regions. Due to its diminutive size, it might prove valuable in creating a race of *Lycoris* hybrids that are small enough to fit almost any garden. See the list of hybrids, later, for several of these smaller ones.

***Lycoris sanguinea* var. *kiushiana*** (Fig. 10). Kiushu, Japan. Compared to the type form var. *sanguinea*, the var. *kiushiana* is more spidery, has longer pedicels, is a larger flower with umbels to 7.5 in., and has a taller scape to 15 in.. It is otherwise like var. *sanguinea* but is likely to enjoy a bit warmer winters when its origin is considered. When purchasing *L. sanguinea* by the dozen, one can find more than one form, size, or shape; any of them are elfin and ephemeral delights. Indeed, the several varieties may just be regularly occurring forms that have been named by those anxious to name. I have never seen var. *alba* or var. *cyrtanthiflora*. *Lycoris koreana* may be a variety of *L. sanguinea* but the authorities seem not altogether in complete agreement.

***Lycoris squamigera*** (Fig. 11, 12). China, Japan, and Korea. Beginning bloom just after or almost at the same time as *L. sanguinea* is this very robust, funnel-form *Lycoris*. Surely everyone with horticultural interests knows of the “Magic Lily” or the “Naked Lady”. It is, after all, probably one of the two widest grown *Lycoris* in the United States and is a reliable ornament in thousands of gardens. The blossom color is usually described as lilac-pink or light carmine rose and with light blue or wisteria blue petal tips and a gold throat. Cool, cloudy weather brings deeper and richer colors. A Natural Hybrid: The authority stating that *L. squamigera* is a natural hybrid between *L. longituba* and *L. sprengeri* would seem to be closer to the mark than other possible pairings that have been proposed; this is simply by way of general morphology. Other possible pairings would involve *L. sprengeri* with *L. straminea*. The *L. straminea* these Japanese authorities are meaning would not be the spider-form *L. straminea* now being sold in the U.S. but the *L. straminea* discussed below as “Yellow

Squamigera”. That is, a pairing of *L. sprengeri* with “Yellow Squamigera” (possibly a form of *L. longituba*) would likely produce *L. squamigera* as we know it so commonly in the U.S.

Foliage is produced in mid- to late winter, usually the first week of February, and remains in good growth until May or even June. The flowers are usually produced about the fourth week of July or the first week of August on a scape varying from 24 to 28 in. but sometimes just 18 or even 30 in. and higher. The 8.5 to 10 in. umbel has 6 to 8 lightly but deliciously fragrant flowers of a trumpet shape. It is one of the two largest *Lycoris* species. Although a triploid, it can set occasional seeds to *L. chinensis* and *L. “sperryi”* pollen! The long-lost var. *purpurea* may actually be *L. sprengeri* or *L. x haywardii*. A narrow leaved form of *L. squamigera* has also been reported.

Many people, when traveling in California, confuse the August and September blooming *Amaryllis belladonna* they commonly see there with *L. squamigera*. However, the pink in the *Lycoris* is smooth, satiny, and pastel, and the flower itself is more refined. The belladonnas produce umbels with more flowers and produce foliage in the fall. Blooming height and date are otherwise somewhat similar. The Magic Lily is not a good performer in Zone 8 and warmer; it prefers colder winters to encourage health and good bloom. Nonetheless, if growers in warm zones pump the bulbs with 0-10-10 fertilizer and otherwise give it a cool site, it can provide some bloom yearly. It is hardy into Zone 5 and I have seen it blooming even in Zone 4 (in West Yellowstone, Montana).

***Lycoris x haywardii*** (Fig. 13, 15). China and Japan. Following quickly behind *L. sanguinea* and *L. squamigera* is this funnel-form, open-spreading *Lycoris*. It looks somewhat like a diminutive form of *L. squamigera* -- in both scape height and flower form and size (Fig. 14 depicts *L. squamigera* as the tall *Lycoris* and *L. x haywardii* as the short *Lycoris*); however, it is a highly fertile diploid. Scapes arise 14 to 19 in., and the umbel of 5 to 7 flowers is 6 to 6.75 in. across. The segments are not undulate but formal, tailored, and narrower than *L. squamigera*. Its color, however, is almost identical with *L. squamigera*: pale orchid to lilac-pink with petal tips in varying shades of blue. The blue coloring is more intense in shade and in cool, moist weather. It has a light, sweet, and delicious fragrance. It will actually self-seed in Zone 7b.

Leaves can start to emerge as early as October but usually wait until

mid-January. It produces better bloom in warmer areas than either *L. squamigera* or *L. sprengeri*. It blooms well in Zones 7 and 8 and the cooler part of Zone 9. Neither the northern limit nor the southern limit of its preferences has been established. Paired with *L. radiata* var. *pumila*, it has produced excellent *Lycoris* hybrids.

Some people are growing what they know as *L. x haywardii*; however, the images of some I have seen show a decidedly spidery form and not the more tailored form that the true *L. x haywardii* has. In short, these spidery-form *Lycoris* seem not to be true to name; they appear to be one or more of the hybrids that could have been created by crossing *L. x haywardii* with *L. radiata* var. *pumila*. These flowers are beautiful *Lycoris*, but they nonetheless are doubtfully the historically true *L. x haywardii*. The true species is pictured on page 66, "The American Horticultural Magazine", April 1962; on page 7, Bulletin No. 5 of the "Louisiana Society for Horticultural Research", March, 1960; **Herbertia**, 1957, page 55; and also herein in Fig. 16.

At least one authority has announced that *L. x haywardii* itself is not a species but is a natural hybrid between either *L. squamigera* or *L. sprengeri* and *L. radiata* var. *pumila*. As *L. squamigera* is a sterile triploid, it seems highly unlikely that it could be one of the parents. While *L. sprengeri* may be a parent, I wonder how it is that out of scores of the *L. sprengeri* x *L. radiata* var. *pumila* cross that I have grown and flowered, not one looks the same as the original *L. x haywardii*. Also, *L. x haywardii* crossed with *L. x haywardii* reproduces *L. x haywardii*. I was taught that a hybrid will have a genetic spread within its selfed seedlings that recaps the two species or parents that made it. Also, I was taught that once even a natural hybrid has reproduced itself within its own ecological niche for a considerable time, that it may then be considered its own species (if otherwise distinct enough) having reproduced itself into its own narrow genetic range and is recognizable and botanically identifiable as such. So, all in all, I wonder if the true, funnel-form *L. x haywardii* is correctly considered a natural hybrid or whether it might really have attained the status of a species. It is especially desirable, under any circumstance, and deserves garden space wherever it can be grown!

***Lycoris longituba*.** China. This is an open trumpet-form flower most of which are nearly white in color (Fig. 17); some individual specimens may have creamy-yellow flowers (Fig. 18); and some may have decidedly



lilac flowers (Fig. 19). Many pastel color variations can be found. Whether these various colors are to be considered the true species is of some slight question. While it is true that a species is not defined by the color of the flower, *L. longituba* hybridizes readily with other *Lycoris* and might have produced a hybrid swarm with many color variations. Where grown in China, there may have been considerable hybridization with nearby yellow or lilac species. In any case some of these color variations might prove especially desirable to some.

*Lycoris longituba* is an impressive *Lycoris*. Scapes usually grow 18 to 27 in. but can grow to 30 in., carry 5 to 8 flowers, and bear an umbel of flowers measuring approximately 8.5 in. across. Some specimens are relatively imbricate while others bear narrow petals. Most carry a light and deliciously sweet fragrance. First blooms appear during the first to second week of August but I have even had precocious scapes as early as the first week of July. As leaf emergence is not until late winter, it is hardy into Zone 6 and probably into Zone 5. Heat tolerance – both summer and winter – is especially good, as it grows and blooms well in Zone 10 in Los Angeles.

While some *Lycoris* are stingy with bloom, this one is comparatively generous. Consequently, it is a good candidate for anyone who wants a rather dependably blooming *Lycoris* to grow. As it is easily fertile – both ways – it is also a fine species to use in hybridizing. The seed it bears are quite large and easy to handle; they also have a high percentage of sprouting and growth. In short, this species and its color variants are highly recommended for any hybridist to utilize. Commercially it is obtainable from many sources and prices are within respectable ranges.

***Lycoris* ‘Off White’** (Fig. 20). Either China or Japan. This is an open trumpet-form flower that is an off-white color and has extremely pale pink stripes along the outside of each petal. In cooler weather it is very slightly infused with pink. This robust *Lycoris* looks much like *L. incarnata*, but its color is not nearly as pronounced or dark in stripe as *L. incarnata*. It blooms on the declining side of *L. squamigera*, which places its peak bloom about the second week of August. It is hardy well into Zone 6, and its leaves appear about the second week of February. Scapes are up to about 25 in. and produce 5 to 7 non-fragrant flowers. Umbels are 8.25 in. across. Even though often attempted in hybridizing, it has proven to be sterile both ways. For a while, I wondered if this bulb could be a form of *L. longituba*. However, *L. longituba* is very easily fertile while *L. “Off White”* is hopelessly

sterile – suggesting the two are not the same. It is a wonderful *Lycoris* as it provides tremendous interest in a lackluster part of the summer.

***Lycoris chinensis* var. *chinensis*** (Fig. 21 shows a typical form; Fig. 22 shows a small form; wide- and narrow-petal forms also exist.) China and Korea. This produces spider-form, light orange to chrome yellow flowers. Scapes are about 14 to 24 in. and carry a 5 to 8-flowered umbel that is up to 9.5 in. across. Leaf emergence is second only to *L. “sperryi”* in its late winter emergence: in the last week of February. It is hardy into Zone 5. First bloom is as early as the second week of July, but peak bloom is usually well into the third week of August. Its heat tolerance is unknown. A fertile diploid, it easily produces seeds and hybrids whether used as a pollen or capsule parent. After many years of great rarity and unavailability, it is now commercially available; no garden should be without it where it is climatically happy. I am unfamiliar with the var. *inuolata*, found in Korea.

***Lycoris* ‘Blue Pearl’** (Fig. 23). Japan probably. This is either a selected form of *L. longituba* or a natural hybrid but could even be a more recently made Asian hybrid. If it is a hybrid, natural or otherwise, the parents are reputed to be *L. chinensis* x *L. sprengeri*. The parents, however, would seem more likely to be *L. longituba* with *L. sprengeri*. It is, nonetheless, one of the most beautiful and reliable *Lycoris* I grow. The color is a pale lilac-blue and is ethereal in its beauty. From 6 to 8 funnel-form flowers are borne on strong 20 to 22 in. scapes that show about the first week of August. Umbels are 8 in. across. There is a very slight fragrance. Its leaves are produced in February and are sometimes cold-burned in Zone 7b, so it would not appear to be especially hardy or at least a reliable bloomer in colder areas. While it will itself produce a very few seed (such as with *L. x haywardii*), its pollen has also worked sparingly with *L. radiata* var. *pumila*, *L. “sperryi”*, *L. sanguinea*, *L. sprengeri*, and *L. x “hay-san”* (*L. x haywardii* x *L. sanguinea*).

***Lycoris* x *houdyshelii*** (Fig. 24, 25). China. This gorgeous spidery flower is reported to be a natural triploid hybrid: *L. straminea* x *L. radiata* var. *pumila*. At least one authority reports that *L. longituba* is one parent, which seems to me to be possible; in this case, the other parent is unclear. While said to be white in color, it is more correct to denote it as light cream, ivory, or parchment, although the general garden effect is white. The white flower sometimes has an extremely thin red line running longitudinally along each segment, but it is not visible unless examined within a few inches. When flowered in full sun, it usually produces rosy tints and hues



**Fig. 9.** *Lycoris sanguinea* var. *sanguinea*.



**Fig. 10.** *Lycoris sanguinea* var. *kiusiana*.



**Fig. 11.** *Lycoris squamigera*.



**Fig. 12.** *Lycoris squamigera*.



**Fig. 13.** *Lycoris x haywardii*.



**Fig. 14.** *Lycoris squamigera* is the tall *Lycoris* and *L. x haywardii* is the short *Lycoris*.



**Fig. 15.** *Lycoris x haywardii*.



**Fig. 16.** *Lycoris x haywardii* – the true species; see the text.



**Fig. 17.** *Lycoris longituba*, white floral form.



**Fig. 18.** *Lycoris longituba*, creamy-yellow floral form.





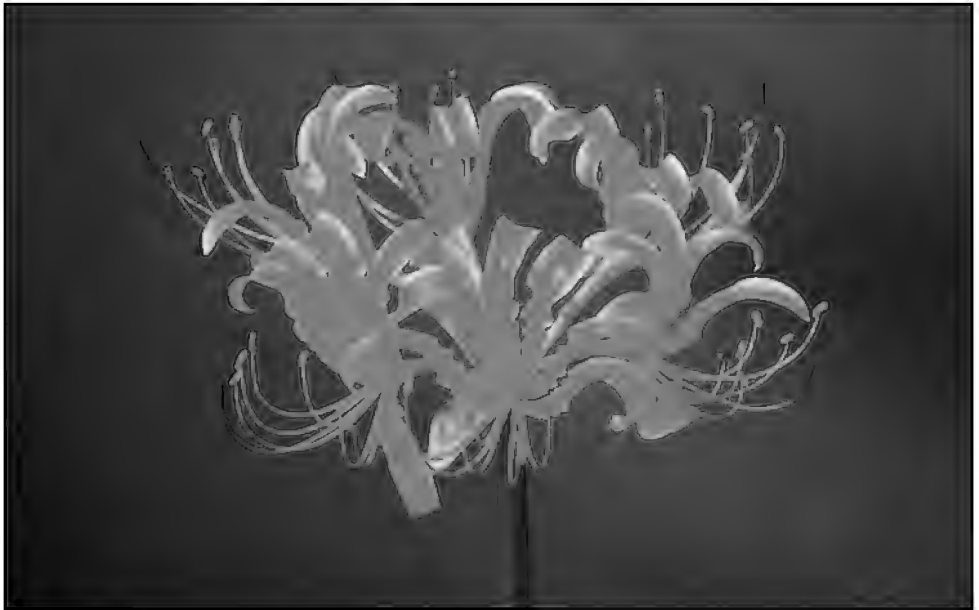
**Fig. 19.** *Lycoris longituba*, lilac floral form.



**Fig. 20.** *Lycoris* 'Off White'.



**Fig. 21.** *Lycoris chinensis* var. *chinensis* typical floral form.



**Fig. 22.** *Lycoris chinensis* var. *chinensis* small floral form.



**Fig. 23.** *Lycoris* 'Blue Pearl'.

as it ages. The stunning flowers can start as early as the first week of July but usually peak bloom is not until mid-August. Umbels are 8 to 9.5 in. wide with 6 flowers (but sometimes 5 to 9), on scapes usually about 20 in. (but sometimes 12 to 26 in.). No fragrance. Infertile, but I and a couple of others have reported a rare seed probably produced by its pollen. Leaves emerge in the first week of October and are a wonderfully glaucous, i.e., blue-green, color. It is probably hardy throughout Zone 7b and perhaps into Zone 6; it is definitely hardier than *L. radiata* var. *pumila*. I am unaware of how it performs in Zone 9 and warmer. It is found native in the Chinese provinces of Jiangsu and Zhejiang. No congenial garden should be without it.

***Lycoris* “sperryi”** (Fig. 26, 27). China. This is a spring-leaved, orange-to golden-yellow spider-form *Lycoris*. It will probably be hardy through Zone 6, but due to its very great rarity it has not been adequately tested to confirm. Also, it is nicely fertile – both to its own and to various other pollens. As it is a fertile diploid, it has produced outstanding hybrids with other *Lycoris*. The bloom scape produces bloom as early as mid-July, but usually peak bloom is about the second or third week of August, just at the end of the *L. chinensis* bloom period. Robust scapes are from 22 to 28 in., and 9 in. umbels usually carry 5 to 7 flowers. The leaves are probably the last *Lycoris* leaves to emerge in late winter, showing about the first or second week of March. In its native China, it grows wild in quite cold areas, places where streams can be frozen so deeply that they can be walked upon.

This *Lycoris* is one of the slowest multiplying *Lycoris* I have ever grown – sometimes taking 20 years to increase from one bulb to two. Consequently, it is a very great rarity. One form I have, however, multiplies a bit better but still too slowly. In any case, I have just a few bulbs due to their recalcitrance.

Traub never named this *Lycoris* but remarked that it is reproductively isolated from the earlier-blooming *L. chinensis*. He believed it was a unique species but I am not so sure. The flowers of the two look almost identical, and it is well known that various individual specimens of a species will produce bloom over a long period. Consequently, that the two bloom, on average, just 10 days apart is suggestive and not dispositive. I have had bloom occasionally overlapping between the two and have “hybrid” seedlings coming along. If it is not the same as *L. chinensis*, then perhaps it is a variety of it. Even the geographical areas of the two are close. However,

Margot Williams of the USDA stated that it and *L. chinensis* have different chromosome morphology; thus, the two could be different species.

***Lycoris shaanxiensis*** (Fig. 28). From the “Shan” state (a state within Burma, now Myanmar). This more-recent commercially introduced *Lycoris* is a reliable and profuse bloomer during the last week of July but more likely during the first week of August in many gardens. This spider-form *Lycoris* bears close resemblance in form to the “red spider lily” but with pale creamy-yellow flowers that can show occasional pinkish to reddish stripes on tepals. Its flower is a light yellow-cream in color and blooms on scapes about 22 to 24 in.. Flower umbels carry 5 to 8 flowers and are about 8 in. across. There is no fragrance. Fall leaf emergence is during the first week of September. It is likely as hardy as the spider-form *L. straminea*, which it rather resembles in form, in bloom time, and in fall leaf emergence.

An occasional rare seed results from careful pollination with the fertile diploid *L. radiata*, but I have not bloomed the cross at this time. Its pollen is strongly fertile with *L. chinensis*, although I have not yet bloomed these seedlings either. It is fully as hardy as the various *radiata* forms and perhaps even moreso. This species has been compared to *L. straminea*. However, this one blooms a bit earlier and also the color is subtly different. See below, under *L. straminea* “Spider Form”.

***Lycoris straminea***. I am growing two unlike forms under the same name. The first one of these is a funnel-form flower with leaves that emerge in late winter. The second one of these is a spider-form flower with leaves that emerge in autumn.

***Lycoris straminea*** ‘Yellow Squamigera’ (Fig. 29). Origin unknown. This form came from Japan to Sam Caldwell<sup>3</sup> in the early 1970’s and thereafter to me. The name is truly descriptive: in every respect the bulb, the leaves, and the flowers look like a “yellow squamigera”; it has thick 18 to 22 in. scapes, carries about 5 to 8 flowers in an 8.5 in. umbel, and begins bloom during the second and third weeks of August. It has no fragrance but is quite fertile, producing abundant pollen and big seeds to its own pollen. Oddly, I have not been able to bloom this one side by side with *L. longituba*, and it is possibly correct to assign it to that species. The Japanese source believed this bulb to

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Footnote <sup>3</sup>: The late Sam Caldwell of Nashville, Tennessee, was the dean of *Lycoris* work. His outstanding attention to acquiring and growing every available species, variety, and form for comparison; making the first sizable number of hybrids; and writing many articles for publication is still of seminal importance at this time and represents a great legacy.

be the true *L. straminea*, which is supposed to be straw-yellow with some red dots and occasional red lines in the flower. What I am growing is a creamy yellow without the red dots or the red lines. Last, my flowers are considerably larger than the original description. Cold hardiness is likely on par with *L. longituba*. Because of size, strength, robustness, and bloom season, it needs to be propagated and grown in every congenial garden. Even if this is not the true *L. straminea*, it is a wonderful *Lycoris* whose garden presentation and time of bloom is first rate.

***Lycoris straminea*** ‘Spider Form’ (Fig. 30). Jiangsu and Zhejiang Provinces, China. In recent years another *Lycoris* has been marketed as *L. straminea*, and it is generally agreed that this one is the true “straminea”. This relatively new to commerce *Lycoris* has a spider-form flower on a more delicate, radiata-like scape reaching about 21 in. in height. The flower umbels are 8 in. or more across and there are usually 6 or 7 flowers. Flowers peak about the second or third week of August. The color is, indeed, straw-like and with considerable rusty-peach suffusions sometimes showing pinkish or red lines and a few scattered red spots. Pantone gives the color as ecru with rosy suffusions. As the flower ages, more rosy tints appear (Fig. 31). There is no fragrance. Fall leaf emergence is in the fourth week of September. While reported as sterile, it makes a few seeds with *L. radiata* var. *pumila* as a pollen parent. At least one or two authorities have decided this one is a natural hybrid between *L. radiata* var. *pumila* and *L. chinensis*. The gross morphology suggests the determination. This *L. straminea* bears a close general resemblance to *L. shaanxiensis* but usually blooms about a week after it. Cold hardiness is likely on par with *L. radiata* var. *pumila*.

***Lycoris incarnata*** (Fig. 32). China and Korea. This one is pale or blush rose-pink with a darker salmon-pink or light reddish stripe down the center of each petal. The flowers are trumpet-form with wavy, undulate edges and are fragrant. Because *L. incarnata* is from areas that become thoroughly dry in mid-summer, it seems to require this drying out more than any other *Lycoris* in order to promote good bloom. Where it is steadily watered all summer, it can be a non-bloomer; however, it is not a desert plant and must always have some soil moisture. During its bloom period, it appreciates high, light shade, as the flowers in full sun can bleach or burn. The plant is robust with 18 to 26 in. scapes. Usually bears 5 to 8 flowers in a 7.5 in. umbel. Bloom is during the second and third week of August. It is a

winter-leaved form with leaves showing about the third week of January. It is a good *Lycoris* in Zones 8 and 7, but probably not so reliable colder than that; its acceptance of warmer climates has not been established. It appears to be a sterile, naturally occurring, triploid hybrid.

***Lycoris radiata* var. *pumila*** (Fig. 33). China. Old descriptions of this plant described it as being a “dwarf” form of *L. radiata*. Well, it is slightly smaller rather than dwarf, and it is highly fertile. Traub wrote that this is the natural diploid form of the species and should thus be named *L. radiata*; the triploid, sterile version (the “Red Spider Lily” discussed below) should be named a variety of this one. It seems that no botanist follows this lead, and var. *pumila* seems now to be the accepted botanical name. This naming anomaly occurred because the triploid *L. radiata* was discovered and described before the diploid form became known.

In any case, it is simply gorgeous and should be seriously sought by every keen gardener. Flower scapes arise to an average of 15 to 18 in., have an average of 6 (but with 5 to 7) flowers, and have umbels of 6.5 in. and even up to 8 in. across, which is just shy of the largest umbel sizes of the triploid *L. radiata* var. *radiata*. Flower color is tomato or lollipop red, which is just about a true red. Flower petals are copiously gold dusted, which is visible when closely examined or when light plays upon the flowers. Its overall traits recommend it for bouquet use (Fig. 34).

It should be more widely grown as it actually seems a bit hardier than the commoner triploid species. It grows and blooms into Zone 6; however, the occasional very harsh winter in Zone 6 can burn the foliage after which there is little late summer bloom. In Zone 7b through the cooler part of Zone 9 it can occasionally self-seed itself into nearby loose soil. In the warmer part of Zone 7b, however, it only rarely produces a self-sown seedling. A couple of reports are that it blooms poorly in the warmer parts of Zones 9 and 10. However, it does marvelously in my Los Angeles Zone 10 garden! This wonderful *Lycoris* is highly fertile with almost any other diploid *Lycoris* and has proved its worth by imparting strength, beauty, and ease of bloom into many hybrids.

It must be forcefully noted that this species produces, perhaps, the most reliable and abundant bloom of all *Lycoris* (where it can be grown), with nearly every bulb producing a bloom scape. If you do not succeed cheerfully in blooming *Lycoris*, and if you cannot succeed well with this one, then it is questionable that you could very well succeed with another

(except *L. squamigera*, where climatically congenial)!

In the USA there are at least three forms based on bloom time, all of which bloom before the first triploid Red Spider Lilies bloom. One fertile form blooms the last week of July to the first week of August in USDA Zone 7b. The form is supposed to have black anthers before dehiscing. I once had three bulbs of this very rare and very early form but very regrettably have either lost them entirely or have lost where they are planted. This earlier bloom period opens up more possibilities for producing hybrids for more mid-summer bloom. I would dearly love to reacquire this early form. To recreate an earlier form of *L. radiata* var. *pumila*, I have for three years lifted the earliest blooming bulbs out of my long, crowded seedling rows when first in bloom. However, these “early” blooming specimens have not actually proved themselves to be so and in succeeding years have disappointingly bloomed with all the rest of their variety. Otherwise, if anyone out there has a source for this very early selection, then surely the secret will not be withheld!

Another form, which I have by the score, the most common fertile form, peaks bloom in the third week of August (the fourth week in July in Los Angeles). This form is the one that I have used exclusively in hybridizing, and it is amazingly fertile. Even the scapes with fading flowers can be cut and placed into a cool, dark place, and numerous seed will still form! It is likely that at least some of this seed is apomictic.

Yet another form peaks in the fourth week of August; this rare form has dark maroon to black anthers before dehiscing. I had it once but have since lost it.

Finally, I have recently bloomed what is unquestionably this species coming from Chen Yi, a Chinese seller of native plants. This form is not quite as large as others, is slightly more a coral red in color, but is otherwise identical in all respects, and blooms with the last of the usual fertile form, with which it makes seed. Except, perhaps, for developing slightly smaller *Lycoris*, there may not be much of a place for this recent import. It is, however, especially pleasing to have a newer Chinese example of the fertile variety, and the color is a slight bit different.

As in almost all species, there are natural variations in bloom time; so surely there are fertile diploid *L. radiata* var. *pumila* with different bloom periods that are still waiting to be imported into the USA or may already be here. Any of these forms is very desirable in the garden, as they bloom at



one of the most flower-anemic periods of the summer. Furthermore, as it bears repeating, *L. radiata* var. *pumila* is probably one of the most reliable blooming of all species *Lycoris*. Only it and *L. shaanxiensis* (below) and the *L. x (L. radiata* var. *pumila x L. x haywardii)* hybrids (below) approach the abandon of flowering that we wish were present in all *Lycoris*.

***Lycoris caldwellii*** (Fig. 35, 36). China. Flower form is intermediate between spider and funnel, perhaps closer to funnel. It opens to a peachy yellow or vanilla cream (P) that quickly fades to a soft, light, creamy yellow and then to ivory or near-white, blooming in the fourth week of August. The color holds better in light shade. Scapes are a tall 20 to 26 in. and bear 4 to 6 flowers, which have no fragrance. Umbels are as wide as 8.5 in.. Foliage emerges in the second week of February. It has been reported hardy into Zone 5; however, it seems also to bloom well in Zones 7 and 8. Likely it will not prove especially adapted to zones as warm as Zone 9. As it blooms so well in many climate zones, it is a natural choice for those wondering what *Lycoris* to use in a garden or open woodland setting. Furthermore, it is quick to multiply. It is infertile both ways. It is thought to be a naturally occurring hybrid, but I cannot find what the putative parents are! (Named after Sam Caldwell.)

***Lycoris sprengeri*** (Fig. 37, 38). China. This fragrant species is like a junior version of *L. squamigera*, but is slightly larger than *L. x haywardii*. Flowers are usually more imbricate than either *L. squamigera* or *L. x haywardii*. Scapes are up to 20 in. or so and appear during the third and fourth weeks of August. The flowers – 5 to 7 per umbel – are a deeper pink or even lilac-rose with a gold throat and with startling ink- or Prussian blue petal tips (Fig. 39). Cool, cloudy days render this *Lycoris* simply gorgeous. It is a refined trumpet shape and produces its leaves about the first week of February. In exceedingly warm autumns, I have seen abundant leaf growth even in November. *Lycoris sprengeri* needs colder winters to produce abundant bloom, so does not do as well in Zone 8 and warmer. Its best zones are probably 7 and 6, where it often produces seed, being a highly fertile diploid species. It has been reported to do well in Zone 5, but this degree of hardiness is not clearly established. This species is one of the parents of Sam Caldwell's hybrids that he named *L. x jacksoniana*, and wonderful things come from it. It is highly fertile both ways with diploid *Lycoris*, and I have little doubt that its genetic capabilities have never been fully investigated. It has a light, sweet, delicious fragrance most noticeable

in the cool of late evenings.

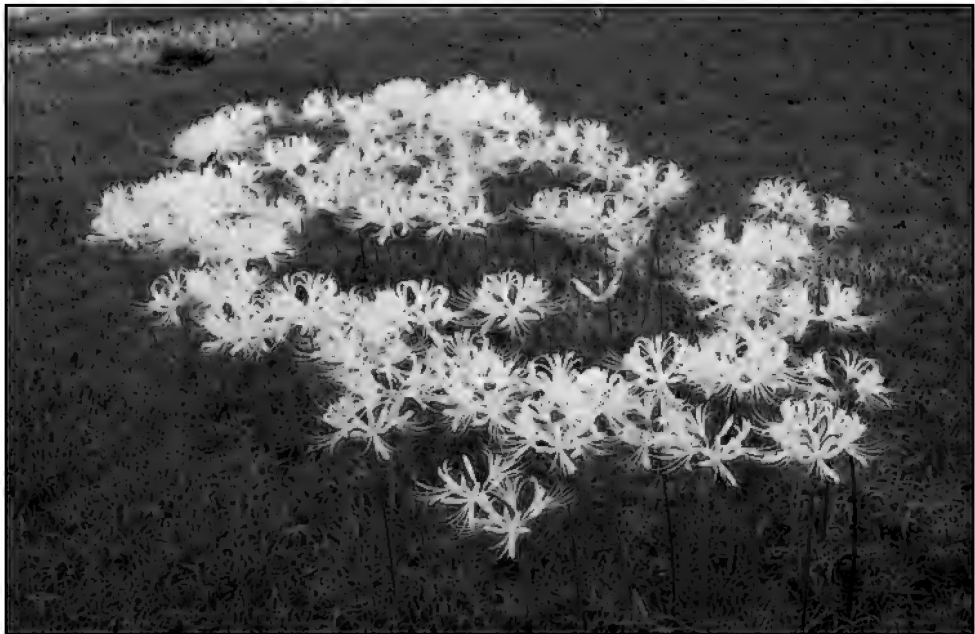
Old references to *L. purpurea* are now known actually to be *L. sprengeri*.

**Special Note on Confusion of Two Yellow Species.** Two yellow species – both spider-form and with fall leaves – are discussed below in their individual sections: *L. aurea* and *L. africana*. In this article I have discussed *L. traubii* Hayward as being *L. aurea*; the application of the name *L. aurea* seems to agree with some current authorities and commercial usage for what is coming out of Japan. The very tender St. Augustine, Florida, *L. aurea* (historical usage) I have discussed not as *L. aurea* but as *L. africana*, which seems also to agree with some current authorities.

Confusion came about because during the late 1940's (and until now), Japanese commercial suppliers have been exporting to the U.S. a beautiful yellow *Lycoris* and have been labeling it *L. aurea*. The name *L. aurea* had already been used for many years for the yellow St. Augustine *Lycoris*, which also is a beautiful flower and is the largest and most tender species. What was coming from Japan and from Florida were not the same *Lycoris*; casual and observant gardeners can discern the differences, especially in hardiness. (A somewhat detailed comparison between these two can be seen in the 1957 **Herbertia**, pp. 40-42.) To distinguish the two and help reduce confusion, Wyndham Hayward of Florida in cooperation with Dr. Traub saw it appropriate to give (in the same 1957 **Herbertia**, p. 41) the Japanese import a new name: *L. traubii*. Only a few authorities have actually picked up the name and used it! Consequently, one will see the names aurea, traubii, and africana confusedly used in the trade and elsewhere between the two species.

As a gardener, I do not enter my opinion as to what name should apply to what particular *Lycoris*. Nonetheless, I know it is important for us all to refer to plants by their accepted names – both common and botanical. I do hope that the best botanical minds might decide once and for all what is what!

***Lycoris aurea*** (Fig. 40, 41). Japan, China, and perhaps Taiwan. *Lycoris aurea* is the yellow *Lycoris* that one can easily purchase from local nursery houses, on the Internet, and from many catalog nurserymen. It is believed to be the *Lycoris* that Wyndham Hayward distinguished and re-named *L. traubii*. To comport with what seems to be current preference, I will use the name *L. aurea*. This *Lycoris* is commercially produced by Japan, and it is suggested by some to be a form of *L. africana* (discussed below). Perhaps so, but among the yellow *Lycoris* it is decidedly hardier than *L. africana*



**Fig. 24.** *Lycoris x houdyshelii*.



**Fig. 25.** *Lycoris x houdyshelii*.



**Fig. 26.** *Lycoris* "sperryi".



**Fig. 27.** *Lycoris* "sperryi".



**Fig. 28.** *Lycoris shaanxiensis*.



**Fig. 29.** *Lycoris straminea* 'Yellow Squamigera'.



**Fig. 30.** *Lycoris straminea* 'Spider Form'.



**Fig. 31.** *Lycoris straminea* 'Spider Form'. As the flowers age, the flowers acquire rosy tints.



**Fig. 32.** *Lycoris incarnata*.





**Fig. 33.** *Lycoris radiata* var. *pumila*.



**Fig. 34.** *Lycoris radiata* var. *pumila* makes a stunning bouquet.



**Fig. 35.** *Lycoris caldwelii*.



**Fig. 36.** *Lycoris caldwelii*.



**Fig. 37.** *Lycoris sprengeri*.



**Fig. 38.** *Lycoris sprengerii*.



**Fig. 39.** *Lycoris sprengerii* with Prussian blue tipped petals.

while more tender than others.

This *Lycoris* should grow and bloom well all through Zone 8 and in protected parts of Zone 7b; it does less well in the warmer part of Zone 9 and in warmer climates. It is an orange to saffron or maize to golden yellow, outfacing, spider lily that produces fall leaves, emerging in October. Bloom peaks about the first or second week of September just about the time most of the forms for *L. elsiae* and *L. albiflora* appear. (See below.) Scapes are 18 to 27 in. and bear a 5 to 8-flowered umbel measuring an impressive 8.5 to 9 in. across. In purchases of this bulb, I have found a few desirable – at least to me – forms that have wider and more undulate segments than the others and that produce quite impressive dome-shaped umbels (Fig. 40). Perhaps other especially fine examples await discovery. It is a fertile diploid in most of its forms and figures in several hybrids. Hybrids between *L. aurea* and *L. sprengeri* are especially variable and interesting in color; they mostly have the winter hardiness of *L. sprengeri*.

***Lycoris “cinnabarinum”*** (Fig. 42, 43). Japan. I obtained this *Lycoris* from the late James Giridlian and his Southern California Oakhurst Gardens many years ago. Blooming during the last week of August or the first week of September, it is a *Lycoris* that in flower form looks somewhat like *L. aurea*. The color – in most forms -- is a blend of light mandarin orange-red with strong suffusion of deep gold-yellow strongest along the center of the petals and with a yellow throat. Several color variants are depicted in the images. The flower color is strong and resists fading in the hot sun. It also blooms on a shorter scape, about 16 to 17 in.. The 8 in. umbel has 5 to 7 flowers. The one bulb I retained finally failed during a particularly cold winter. It is about as hardy as *L. aurea* with leaves emerging in late September, and it seems to have found its cold limit in zone 8. It is slightly pollen fertile, but it is pod difficult.

Years ago Margot Williams of the USDA genetically studied a bulb I provided and determined that it is a hybrid between *L. aurea* and *L. sanguinea*. As there are various forms that morphologically appear to be intermediate between the two, her opinion seems correct. Because these two species usually have such disparate bloom periods, she surmised that it must be a human-originated hybrid. Although likely, this is not a sure conclusion, as *L. sanguinea* can produce scapes, when pushed with ample water, as late as the first week of September. Slightly early blooms of *L. aurea* could then naturally overlap with *L. sanguinea*, thus facilitating natural hybridization.

Even so, whatever its origin, it is a distinct color within the species. A more pastel melon form is particularly appealing to me.

***Lycoris albiflora* and *L. elsiae*.** Japan and China. These two are named selections from a large swarm of natural hybrids between *L. radiata* var. *pumila* and *L. aurea* (Traub's *L. traubii*). The principal bloom time for all of them is during the end of August and through the second and sometimes third week of September. Many forms have been found, and most are becoming garden flowers. *Lycoris albiflora* (Fig. 44) opens a very pale yellow or yellow cream, and the recurved tepals sometimes have a subtle pinkish central stripe. Scapes are 19 to 23 in. and umbels are 8.5 to 9 in. wide with 6 to 8 flowers per umbel. It is reputed to be highly sterile. It and *L.* "Morrison's White No. 1" are apparently the very same.

*Lycoris elsiae* is basically a moderate-sized, spider form, fall-leaved *Lycoris* that has been described as "a soft, illusive pastel blend of cream, buff, yellow, salmon, and pink tints, with deepest pinkish shading along the center of each segment. It is strongest when the blossom first opens, varies from day to day and in different light, and finally fades almost away leaving a flesh colored or nearly white flower." How is that for a color description! Scapes are 12 to 15 in. and umbels are up to 8.5 in. wide. Figure 45 depicts a flower similar to, or that may be, the type form for *L. elsiae*.

Various other examples in this complicated group vary from pink and salmon on one extreme through pale yellow to cream and nearly white on the other, and there are many color and scape height variations. They are usually commercially available in mixture. They are hardy and bloom well into the warmer part of Zone 7b. Their preference for Zone 9 and warmer areas is unknown; however, they do well in my Zone 10 garden. A couple of near-white selections, 'Marshall's Fertile', as well as the one I call 'Giant Pink', will set a few seed with diploid mates. Umbels carry 5 to 9 flowers but usually 6 or 7. The *L. albiflora* - *L. elsiae* complex of hybrids are among the first *Lycoris* to show their leaves in the autumn; leaf emergence starts in late September.

It is worth noting here that Caldwell (1964 **Plant Life**, p. 58) noted three general representations of this entire group. The first, a majority of those coming from Japan, are the soft salmony-toned type named *L. elsiae* by Dr. Traub. A second group has flowers larger than the first with crisped and broader segments, more reflexed, and a pale soft yellow throughout; scape heights are similar to the first group. A third group is much larger than the

*L. elsiae* group with tall scapes (up to 24 in.) and with pale apricot to pink coloring. All are examples from the large number of natural hybrids.

That there should be naturally occurring hybrid siblings, one selection named *L. albiflora* and another selection named *L. elsiae* confounds me. If this were proper, many selections from this large hybrid group of siblings could easily be given scientific names. This is not for me to decide. It does, however, seem to my gardener's sensibilities to be an area needing full botanical clarification.

Below are some older forms that have been selected by various enthusiasts. Except for *L. elsiae* 'Goedert Yellow', which usually blooms in mid to late August, all these bloom during the more usual first two weeks of September.

***Lycoris albiflora* 'variants'** (Fig. 46). Japan and China probably. This image came from Caldwell many years ago as a slide and shows five variants he had. Starting at the lower left is "Morrison's White No. 1", to its right is the type clone for *L. elsiae*, above it is "Morrison's Small Pink", above and to the right is "*albiflora carnea*" and below it to the right is "Morrison's Light Rose Pink". Whether all of these can still be found in large groups of purchased bulbs or in some gardens is a matter of conjecture. For the adventurous – and for those willing to pay the sometimes steep price – it would be a botanical journey to try to find these variants, some of which may be lost or exceedingly rare.

***Lycoris elsiae* 'Goedert Yellow'** (Fig. 47). Japan probably. A medium yellow selection that may not even be a selection out of *L. elsiae*! Scapes arise 15 to 18 in. and carry a quite large 9.25 in. umbel. The yellow is softer and easily sets it off visually from *L. aurea*, which sometimes blooms at the same time. This now rare variant seems a bit tenderer than some and is recommended for Zone 8 and warmer. It is possible that the yellow-form *L. 'cinnabarinum'* shown in Fig. 43 may be the same as 'Goedert Yellow'; a comparison can only be made when I can re-acquire the former to put them side by side. Similar bloom dates are suggestive. Found in the 1950's by the bulb dealer Robert Goedert of Florida.

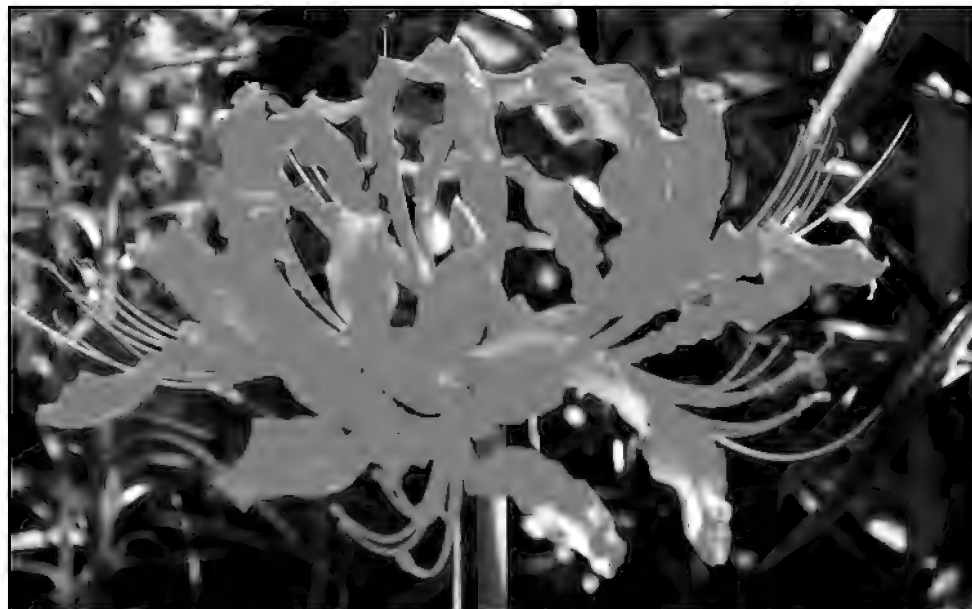
***Lycoris elsiae* 'Giridlian's *albiflora carnea*'** (Fig. 48, 49). Island of Kyushu, Japan. *Lycoris elsiae* 'Giridlian's' *albiflora carnea* is a large, robust selection and has been known occasionally to produce a seed. Hardy and blooms well into Zone 7b.

***Lycoris elsiae* 'Pinkest Yet'** (Fig. 50). Japan probably. An early light pink





**Fig. 40.** *Lycoris aurea* (*Lycoris traubii*).



**Fig. 41.** *Lycoris aurea* (*Lycoris traubii*).



**Fig. 42.** *Lycoris "cinnabarinum"*.



**Fig. 43.** *Lycoris "cinnabarinum"*.

selection of mine. Better for Zone 7b or warmer.

***Lycoris elsiae* ‘Morrison’s White No. 1’** (Fig. 51). Japan and China. Yellow cream to near white selection made by the late B. Y. Morrison. It or identical ones can often be found in large purchases of “albiflora” commercially available. This beautiful selection becomes closer to white as the days progress – just the opposite behavior to *L. x houdyshelii*. It is hardy into Zone 7b and its attractiveness should pave its way into many gardens. It and *L. albiflora* are apparently (almost) the same.

***Lycoris elsiae* ‘Polly’s Green’** (Fig. 52). Japan probably. A very rare greenish selection made by the late and respected Polly Anderson of La Canada, California. It is not very cold hardy and needs Zone 8 warmth – or warmer.

***Lycoris elsiae* ‘Giant Pink’** (Fig. 53). Japan probably. A tall, robust, light pink selection I made years ago. It could be the same cultivar that William Lanier Hunt, founder of the Hunt Arboretum (now the North Carolina Botanical Garden), found many years ago and dubbed “Porcelain Pink”. The aforementioned Margo Williams was impressed with “Giant Pink” and found it to be slightly seed fertile. Rare and hardy into Zone 7b.

***Lycoris elsiae* ‘Marshall’s Fertile’** (Fig. 54). This form of *L. elsiae* is somewhat seed fertile if repeatedly pollinated over several days.

***Lycoris elsiae* ‘Morrison’s Light Rose Pink’** (Fig. 55). Japan probably. This variant may be lost to commerce; perhaps someone still has it. My selection *L. elsiae* ‘Pinkest Yet’, above, may be the same.

***Lycoris elsiae* ‘Morrison’s Small Pink’** (Fig. 56). Japan probably. A vigorous, small, pink selection. Not fertile, but it takes winters in Zone 7b with impunity and can always be counted upon to bloom well.

**Other Forms.** Several of the many forms – some subtle and some not so subtle – found in this group are shown in Fig. 57 (an early season yellow cream), Fig. 58 (a light pink), Fig. 59 (pink), and Fig. 60 (a late season yellow-cream).

***Lycoris radiata* var. *radiata*.** China, Japan, and nearby. Does the “Red Spider Lily” of the American South need any introduction! This triploid is grown by the untold millions in the American South, where it seems quite at home; and I have seen beautiful plantings of it growing and blooming at house sites totally abandoned for many years. At my family home, there must be more than 3,000 bulbs of it. If familiarity breeds contempt, then this is the flower that will dispel the saying. The “Red Spider Lily”



**Fig. 44.** *Lycoris albiflora*.



**Fig. 45.** *Lycoris elsiae*.



**Fig. 46.** *Lycoris albiflora* 'variants' – see text. Photo by Sam Caldwell.



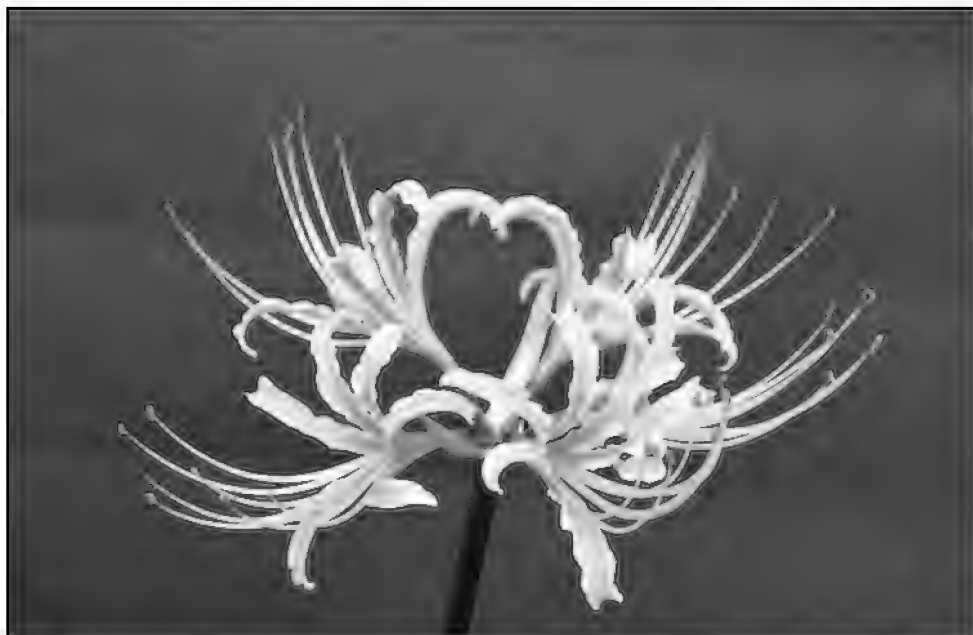
**Fig. 47.** *Lycoris elsieae* 'Goedert Yellow'.



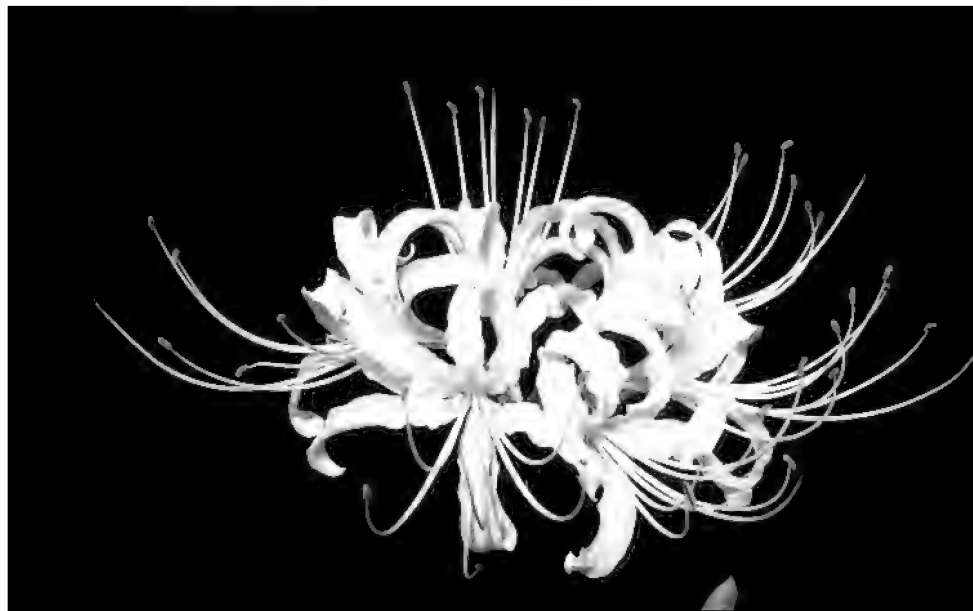
**Fig. 48.** *Lycoris elsieae* 'Girdlian's albiflora carnea'.



**Fig. 49.** *Lycoris elsiae* 'Giridlian's albiflora carnea'.



**Fig. 50.** *Lycoris elsiae* 'Pinkest Yet'.



**Fig. 51.** *Lycoris elsiae* 'Morrison's White No. 1'.





**Fig. 52.** *Lycoris elsiae* 'Polly's Green'.



**Fig. 53.** *Lycoris elsiae* 'Giant Pink'.



**Fig. 54.** *Lycoris elsieae* 'Marshall's Fertile'.



**Fig. 55.** *Lycoris elsieae* 'Morrison's Light Rose Pink'.



**Fig. 56.** *Lycoris elsiae* 'Morrison's Small Pink'.



**Fig. 57.** An early season yellow cream form of *Lycoris elsiae*.



**Fig. 58.** A light pink form of *Lycoris elsiae*.



**Fig. 59.** A pink form of *Lycoris elsaie*.



**Fig. 60.** A late season yellow-cream form of *Lycoris elsaie*.

is one of the most extraordinarily beautiful *Lycoris* and was introduced into cultivation in the Western world about 1750. If it were rare, it would be perhaps the most sought *Lycoris*. Yet, we can have this beauty in great numbers. The carmine red, spidery flower is not just a color of purity and impact, but it is gloriously gold-dusted. In the first cool spells of September it fairly scintillates in sun or shade. If it had fragrance and lasted indefinitely, we would have to say it is perfect.

There are several forms of this stalwart bulb. I have dubbed the earliest one *L. radiata* var. *radiata* ‘Modern Japanese’ (Fig. 61). It reaches peak bloom during the first week of September in Zone 7b. It is visually almost identical with the Southern Heirloom form, but it may possibly be just smaller, a slightly darker rose red, and really does bloom a week or so earlier. Oddly, I have found a rare open-pollinated seed on this one, for which I have no explanation. Also, this is the typical one that is now being exported into the U.S. from Japan and actually blooms better than the historic Southern Heirloom form.

The typical heritage or Southern Heirloom form (Fig. 62, 63) cannot be purchased from import sources; it is propagated by its American growers and commonly either sold or passed about among friends. Scapes average 18 in.; 5 to 7-flowered umbels measure about 8 in.; some umbels achieve nearly 9 in. in width. The individual flowers are a dark rose red and are heavily gold dusted. This heirloom form often does not bloom as freely as one would wish; sometimes only one in five bulbs will bloom . . . or fewer! This more usually encountered form, the one grown so extensively in the American South, reaches peak bloom about the third or fourth weeks of September, with flowers sometimes as late as the end of October, based on local weather and growing conditions. The fall leaves start emerging about the fourth week of September, are among the first *Lycoris* leaves to emerge, and continue showing up into October. It is perfectly at home in Zone 8 and is almost as happy half a zone warmer and colder. It is not reliably winter hardy in Zone 6; however, it is reported that there is a very protected, surviving clump even in Indianapolis, Indiana, and in Ohio! It is said not to be so floriferous in central Florida and southward. Some authorities say it does better in heavier soils, but I could not confirm the idea. I believe it ramps in sandy loam as well as various other soil types. Thus, with this one as well as the earlier form, one can have the “Red Spider Lily” in bloom the entire month of September and some years even

into October.

A third form (no image available), from China, was named by Dr. Traub as *L. josephinae*, after its importer, Josephine Henry of Gladwyne, PA. I cannot tell that *L. josephinae* is unusually distinctive, but that is a matter left to professional botanists.

A fourth form is one called “black red” or “dark red” (Fig. 64), is from Japan, and is basically the same as the others but is definitely darker. I have not been able readily to set seed on it, so I assume it might be a triploid; nonetheless I have surprisingly seen a rare seed or two naturally produced. It is the same height as the others; its flower segments may not be quite so wide.

And there is even a double form (no image available) that has been recently marketed as *Lycoris radiata plenum*. Some might consider it outstanding while others might consider it a monstrosity; individual tastes are to be respected!

I have never seen var. *terracciani*, and it may not be a valid variety anyway.

***Lycoris africana*** (Fig. 8, 65). The name is a misnomer since it is not found in Africa but in South China, Viet Nam, Myanmar [formerly Burma], and possibly Formosa. This is the *Lycoris* that some authorities – including Dr. Traub – refer to as *L. aurea*. However, to distinguish this species from *L. aurea* and *L. traubii* as discussed above, I will – right or wrong – use the name *L. africana*, which seems to have some published preference. This is the huge spider-form, fall leaved, light golden to yellow *Lycoris* that abounds in the St. Augustine, Florida, area as well as along the American Gulf Coast. Umbels with a gentle uptilt carry 5 to 10 flowers and are up to 9 in. wide. *Lycoris africana* has tall scapes, up to 30 in.; the incredibly wide leaves – the largest in the genus – likewise, grow to the same length. This species needs very abundant water year-round even during dormancy in the summer: it comes from tropical areas that receive up to 100 in. of rain spread evenly through the year. Peak bloom is the last week of September and the first week of October, and I have had flowers as late as the fourth week. It seems to prefer slightly alkaline soils. Also, this is the one *Lycoris* that takes well to pot culture.

It is the tenderest species known within the genus and blooms to perfection in Zone 9. In warmer climates it becomes less floriferous. In colder climates it can be killed by cold winter weather. Indeed, I rate it

excellent in Zone 9, good in Zone 8 only in quite well-protected locations, and impossible outside anywhere in Zone 7b. The more commonly available form is modestly fertile, and hybrids between it and *L. radiata* var. *pumila* are visually close to selections in the albiflora – elsia group. It also readily hybridizes with forms of *L. aurea*. Interestingly, seedling bulbs from intercrossed *L. africana* began blooming in just six years – the fastest *Lycoris* from seed to bloom that I have ever observed.

True *L. africana* seems only available from those who grow it along the U.S. Gulf Coast and particularly from the St. Augustine, Florida, area. Current commercial offerings under the name *L. aurea* are, indeed, true to that name and are not *L. africana*. If you can find and grow it, you will have a treasure for many years.

Two or three varieties of *L. africana* may exist, but I am unfamiliar with them.

**Other Species or Wild Forms.** There are other species or wild forms not covered here, which I do not have. These are *L. anhuiensis* (a pure yellow with spring-emerging leaves, from China), *L. argentea* (a lilac or lavender *Lycoris* from Burma and lost to cultivation), *L. x chejuensis* (a likely natural hybrid found in Korea), *L. x flavescens* (a likely natural hybrid between *L. chinensis* and *L. sanguinea* var. *koreana*, found in Korea), *L. guangxiensis* (yellow with reddish stripes or bands, China), *L. koreana* (a Korean *Lycoris* placed by some authorities as a variety of *L. sanguinea*), *L. rubroaurantiaca* (a yellow natural hybrid between *L. aurea* and *L. sanguinea* and found in Kyushu, Japan), and *L. x rosea* (China). *Lycoris x rosea*, is a dark rose hybrid between *L. radiata* var. *pumila* and *L. sprengeri*. Indeed, many crosses I have made between these last two species are morphologically identical to (“look” the same as) *L. x rosea* and so tends to confirm the parentage. Chen Yi, an exporter out of China, offers several species or wild forms under various names that may or may not be different from those discussed above. Unknown species or hybrids may yet come out of Asia, so this remains an interesting horticultural arena.

#### SOME RECENT LYCORIS HYBRIDS

The bloom sequence for the hybrids discussed below is based on the date the first bloom was usually recorded. Due to exposure, growing periods, moisture content of the soil, temperatures, and other factors, bloom can begin almost a month later in some and thus alter the sequence!





**Fig. 61.** *Lycoris radiata* var. *radiata* 'Modern Japanese'.



**Fig. 62.** Typical heritage or Southern Heirloom form of *Lycoris radiata* var. *radiata*.



**Fig. 63.** Typical heritage or Southern Heirloom form of *Lycoris radiata* var. *radiata*.



**Fig. 64.** "Black red" or "dark red" form of *Lycoris radiata* var. *radiata*.



**Fig. 65.** *Lycoris africana*. (Dr. Traub's *Lycoris aurea*.)

Furthermore, different seedlings in the same cross may exhibit some difference in bloom periods. This actually is good, because one could thus have them blooming for a long time.

There are issues regarding the fertility of both species and hybrids. While some crosses may seem to be infertile, it should not be considered a foregone conclusion. Jan de Graaf, one of the greatest plantsmen of the 20<sup>th</sup> Century and famous for the ground-breaking work he did with true lilies, found that some individual plants may certainly be infertile. But he carefully worked many lilies of the same species or hybrids and found that some were highly fertile. The lesson is clear: we need to attempt even difficult crosses many times and with different parents before we conclude that the cross is surely infertile.

These hybrids are a quite small number of all that I am growing. Many of them are the ones that I have had long enough or in large enough numbers to prove their mettle. Other hybrids I have, from one bulb to many, are still under observation. Indeed, there are now many *Lycoris* hybrids and the effort to present and discuss each one is impossible. Note that I instead have given relatively brief and concise information on each one. They are usually a blend of the parents – including bloom time – so you may refer to the parents to get an idea of their needs and behavior.

#### INTERSPECIFIC HYBRIDS

**A. *Lycoris* x *haywardii* x *L. sanguinea*** (Fig. 66). This is a 15 to 21 in. charmer. Caldwell first made the cross, and he was not very enamored of it. I think, however, that it is first-rate, beginning bloom as early as the middle of July when the garden is really in the doldrums. All flowers of this cross that I have bloomed look much like the image. The non-fragrant, funnel-form flowers appear in 6 to 6.5 in. umbels with 4 to 5 flowers, and they are very easily fertile. They are sun-sensitive and need to be grown in high, light shade. Leaf emergence is in late winter. This group may open hybridizing for smaller or more diminutive *Lycoris*. Self-pollination has produced a small hybrid that has an unusual grey bloom (Fig. 67).

**B. *Lycoris* x *haywardii* x *L. chinensis*** (Fig. 68, 69). Siblings in this cross look similar but the second image shows wider petals. The parents, being funnel-form on one side and spider-form on the other, produce seedlings that fit neither category easily. In any case, they are wonderfully hardy at

least into Zone 7b, bloom well, and multiply at a fair rate. The scapes are usually about 16 to 17 in. and bear 5 flowers in a rather large 8 to 8.5 in. umbel. Bloom begins as early as July 14 and is usually on the same schedule each year. The pastel yellow flowers usually bleach to nearly white in full sun (Fig. 70). Surprisingly, it is hardly fertile.

**C. *Lycoris elsiae* x *L. chinensis*** (Fig. 71). This cross was made by Margot Williams when she was with the U.S. National Arboretum. She found that a form of *L. elsiae* she had would occasionally produce a seed, so she used *L. chinensis* as a pollen parent. There was a time when *L. chinensis* could not be commercially obtained, and this slightly fertile hybrid could have been used as a bridge plant to produce many winter-hardy yellow *Lycoris*. Now, *L. chinensis* is readily obtainable, so this hybrid may not be so important. I have just this one clone, which is modest in multiplying. Bloom appears over a wide period from early August to early September. Scapes at 18 in. produce 6 in. umbels with 6 flowers. The flowers sometime develop a slight and pleasing pink flush as they age (Fig. 72). There is no fragrance. Leaves emerge in late winter. All in all, this is a first-rate flower that does well in Zone 7b and is likely to withstand harsher winters.

**D. *Lycoris* “sperryi” x *L. sanguinea* var. *kiushiana*** (Fig. 73). This interesting hybrid blooms during the first week of August. Considering the parents, it is completely winter hardy. The color at bloom time is a welcome bright spot in the garden. Talking about slow multipliers: I think I may have just a couple of bulbs after 25 years! Slightly fertile, and the few seedlings I have from it are just as slow as the parent! Why is it that we so admire things that are so slow . . . perhaps because they are so rare? The 15 in. scapes bear 5 flowers in a 5.5 in. umbel; the color is a clear golden-yellow. Coming in the doldrums of summer, these could make a beautiful show if only there were a sizable colony!

**E. *Lycoris radiata* var. *pumila* x *L. “sperryi”*** (Fig. 74, 75). This is slow multiplying for me, much like its pollen parent, and is a beautiful flower. Consequently, I have recently remade a similar cross by pollinating many scapes of the same seed parent but with *L. chinensis* as the pollen parent. The creamy yellow flowers with rosy-red filaments usually bloom during the first or second week of August but sometimes do not appear until the

very end of the month. The 18 to 23 in. scapes bear 6 to 7 flowers in a 6.75 to 8.5 in. umbel. It is slightly fertile and foliage comes in the fall. The two or three cultivars I have of this cross look somewhat like the albiflora-elsiae complex; however, these have wider segments than most and are more winter-hardy. They bloom fairly well even after colder winters in Zone 7b, while *L. elsiae* is sometimes marginal in bloom production. This probably validates the gene study indicating that the yellow parent in the elsiae-complex is probably the semi-tender *L. aurea* and not one of the winter-hardy yellows. Hybrids of *L. radiata* var. *pumila* x *L. chinensis* are indistinguishable from this cross and bloom at approximately the same time (Fig. 76).

**F. *Lycoris* x *haywardii* x *L. “sperryi”*** (Fig. 77). I love these. These near-white flowers are basically indistinguishable from the *L. x haywardii* x *L. chinensis* bulbs I have and for all practical purposes are the same. Scapes may be, oddly enough, a bit taller at 18 to 22 in. and the umbels are a wee bit larger at 9 in.. Six flowers is the norm. Being from two spring-leaved, hardy parents, this one is hardy as well and has spring leaves too. Now if they would only multiply faster!

**G. *Lycoris radiata* var. *pumila* x *L. x haywardii*** (Fig. 78-84). This may be the finest group of hybrids that I grow. While the flower form is always somewhere between the spidery capsule parent and the mostly funnel-form pollen parent, there are color variations. Colors run from pink to magenta to rose with blue petal tips. But none is red like the capsule parent. Scapes run 14 to 18 in. and have 5 to 7 flowers in 6.25 to 7 in. umbels. Bloom begins as early as the second week in July and various ones bloom through August. There is no fragrance. If I had to grow just one group of hybrids, this might be it. It is winter hardy certainly to Zone 7b, the freest and most predictable in bloom of all hybrids I grow, and most cultivars multiply with great strength and vigor. What else does one need, except perhaps a soaking to guarantee large numbers of them! I have second generation hybrid bulbs, and the results are indistinguishable from the first generation!

**Comparing the “ra-hay” Hybrids with the “Jackson” Hybrids:**

The next group of hybrids – the *L. x jacksoniana* group – is in many ways comparable to those discussed in this section. The main four visual differences are that the *L. radiata* var. *pumila* x *L. x haywardii* hybrids usually bloom earlier; their colors are usually in the lighter pink ranges; the scapes are a bit shorter; and the segments are a bit narrower. These are subtle rather than obvious differences. Culturally, the “ra-hay” hybrids are likely a bit more tender and tend to do well from Zone 7b to warmer climates. The “Jacksons”, below, are a bit more hardy and tend to do well in Zone 7b and colder climates. Note that the parentage of the “ra-hay” group is  $\frac{3}{4}$  *L. radiata* var. *pumila* and  $\frac{1}{4}$  *L. sprengeri* (if botanists are correct about the parentage of *L. x haywardii* – but see the discussion under *L. x haywardii* regarding this issue). The parentage of the “Jackson” hybrids is  $\frac{1}{2}$  *L. radiata* var. *pumila* and  $\frac{1}{2}$  *L. sprengeri*. The same pollen parent in both groups but in differing genetic percentages would explain the relative cold hardiness of each as well as the width of segments each displays.

**H. *Lycoris x jacksoniana*** (Fig. 85-88). Sam Caldwell created and named this group of hybrids after President Andrew Jackson also of Nashville, Tennessee. Parentage is *L. radiata* var. *pumila* x *L. sprengeri* and the reverse. While I find the *L. radiata* var. *pumila* x *L. x haywardii* hybrids to be among the best, I think Caldwell liked this cross because the pollen parents are so similar but *L. sprengeri* is hardier. Otherwise, the “Jackson” hybrids have slightly taller scapes at 16 to 18 in., and the umbels are also a tad larger at 6.5 to 7.5 in.. There are as many as eight flowers in an umbel. Bloom begins during the first week of August and continues with different cultivars into the first week of September. Foliage comes in the fall, like the capsule parent. The “Jackson” hybrids have no fragrance, range in darker more saturated magenta colors than the “ra-hay” group of hybrids, have some interesting red flowers, and usually have broader segments.

Caldwell lamented that he had no *L. x jacksoniana* that was spring-leaved with the associated winter hardiness. However, I have one that is late winter-leaved and has a surpassingly beautiful, dark rose flower. Indeed, I think this is one that is worthy of commercial exploitation. It is probable that the “Jackson” hybrids are hardier than the *L. radiata* var. *pumila* x *L. x haywardii* hybrids, but this has not been confirmed.

**I. Commercial Hybrids.** At least one commercial hybrid assuredly has a



**Fig. 66.** *Lycoris* x *haywardii* x *L. sanguinea*.





**Fig. 67.** A small hybrid produced by self pollinating *Lycoris x haywardii* x *L. sanguinea*.



**Fig. 68.** *Lycoris x haywardii* x *L. chinensis*.



**Fig. 69.** A form of *Lycoris x haywardii x L. chinensis* with wider petals.



**Fig. 70.** The yellow petals of *Lycoris x haywardii x L. chinensis* usually bleach to nearly white in full sun.



**Fig. 71.** *Lycoris elsiae* x *L. chinensis*.



**Fig. 72.** Petals of *Lycoris elsiae* x *L. chinensis* sometimes develop a slight pink flush with age.



**Fig. 73.** *Lycoris* "sperryi" x *L. sanguinea* var. *kiushiana*.



**Fig. 74.** *Lycoris radiata* var. *pumila* x *L. "sperryi"*.



**Fig. 75.** *Lycoris radiata* var. *pumila* x *L.* "sperryi".



**Fig. 76.** *Lycoris radiata* var. *pumila* x *L. chinensis*. Note similarity to Fig. 74, 75.



**Fig. 77.** *Lycoris* x *haywardii* x *L.* "sperryi".



**Fig. 78.** *Lycoris radiata* var. *pumila* x *L.* x *haywardii*.



**Fig. 79.** *Lycoris radiata* var. *pumila* x *L. x haywardii*.





**Fig. 80.** *Lycoris radiata* var. *pumila* x *L. x haywardii*.



**Fig. 81.** *Lycoris radiata* var. *pumila* x *L* x *haywardii*.



**Fig. 82.** *Lycoris radiata* var. *pumila* x *L* x *haywardii*.



**Fig. 83.** *Lycoris radiata* var. *pumila* x *L. x haywardii*.



**Fig. 84.** *Lycoris radiata* var. *pumila* x *L. x haywardii*.

“Jackson” element to it: *L. ‘Ueki’* (Fig. 89). It is not available commercially. It originated in Japan, has excellent petal width, and is a fine addition to the summer garden for those who can obtain it.

**J. *Lycoris aurea* x *L. radiata* var. *pumila*** (Fig. 90). Unfortunately, this may be a cultivar lost to cold due to its somewhat tender capsule parent. It is a lesson to all of us to treat unproven hybrids with care until its constitution is proven. When I was sure I had it, bloom came during the third week of August. As both parents are readily available, it might be worth remaking the cross.

**K. *Lycoris sprengeri* x *L. haywardii*** (Fig. 91). The attempt to make a hybrid with unusually blue segment tips did not work. One resulting seedling is a straight pink; the other seedling has more blue but not as much as anticipated! It blooms at the end of August or the beginning of September.

**L. *Lycoris africana* x *L. x haywardii*** (Fig. 92). This hybrid between a very late blooming capsule parent and an early blooming pollen parent makes tallish scapes at 20 in. and usually has 6 pale flowers in an 8 in. umbel, showing in late August or more usually in early September. Foliage emerges in the late fall. *Lycoris x haywardii* has given its relative winter hardiness to this hybrid, as there is little hardiness in *L. africana*! It is marginally good in the warmest part of Zone 7b, and I would not rate it acceptable anywhere north of there. As it is, I grow it in a protected warm pocket, and the leaves are considerably damaged by cold winter nights. (I have treated *L. x haywardii* as a species here rather than as a natural hybrid.)

**M. *Lycoris africana* x *L. radiata* var. *pumila*** (Fig. 93, 94). This early September blooming hybrid has, to confound our thinking, proved hardy in 30 years of winters in Zone 7b without protection! However, the more northerly limit of its strengths has not adequately been tested. Foliage appears in late September to early October. Tall 23 in. scapes with 8.5 in. umbels make an impressive display in pale yellow. Red stigma tips as well as a few red lines lengthwise along a few petals also add to the interest. In fact, a clump in full bloom is impressive as it makes such a show at this time. Several cultivars of this cross look almost identical, but an especially attractive one made by Caldwell has broader segments; this one also

develops pale pink flushes as it ages.

**N. *Lycoris sprengeri* x *L. aurea*** (Fig. 95). Here is a hybrid from a funnel-formed, winter leaved seed parent pollinated by a spidery, fall leaved pollen parent. The blend of lavender with blue tips on one side with golden yellow on the other has produced an unusual result, most reckoned as a pale butter yellow that fades a little with maturity. The early to mid September scape is about 23 in., and the six-flowered umbel is 8.75 in. across. Hardy in Zone 7b. This is one of the crosses that has not been well explored but has produced differing results; interested hybridizers would be well advised to remake it many times over. (Image from the author's Zone 7b garden and made by Nancy M. Scheiderman.)

**O. *Lycoris sprengeri* x *L. x haywardii*** (Fig. 96). This cross was an attempt to create a bluer flower, and the results at least point in that direction. Bloom comes late for such a cross: during the first week of September. Fertile and hardy in Zone 7b. Otherwise, descriptions of the plant and flower are a predictable blend of the parents.

**P. *Lycoris* x *washingtonia*** (Fig. 97, 98). This was hybridized by Dr. John L. Creech (of the U.S.D.A.?) in 1950. I obtained a bulb in the 1970's, and increase has been fair but not outstanding. The parents are *L. radiata* var. *pumila* and *L. chinensis*. It is probably at its best in Zones 8 and 7. It has beautiful, very geometrically perfect flowers. The 15 in. scape usually has 5 or 6, soft buttery yellow flowers in a 6 in. umbel, and blooms in late August to early September. As the flowers mature and age, they develop rose-red tints and flushes, betraying the capsule parent. Altogether, a flower that should be more widely grown if stock was available. Fertility is not fully tested.

**Q. *Lycoris sprengeri* x *L. aurea*** (Fig. 99). Here is another example of the cross more thoroughly discussed above. The smoky-blue color is genuinely unusual among *Lycoris*, but it does illustrate that future color breaks in the genus are yet to be created. Bloom comes in the first or second week of September. Fertile and hardy in Zone 7b.

**R. *Lycoris* x 'Blushing Lady'** (Fig. 100). This commercially available hybrid is either a selection out of the albiflora-elsiae complex or from

*L. shaanxiensis* or from *L. straminea*. The flowers and the leaves “look” the same as any of these three; however, it blooms during the same time (first or second week of September) as the first. It is figured here because it is possible it is of hybrid origin. It originates from Japan and is a fine addition to the late summer garden: an unusually large flower in clear pink that is not easy to find otherwise in a spider-form *Lycoris*. (Image from the author’s Zone 7b garden and made by Nancy M. Scheiderman.)

**S. *Lycoris radiata* var. *pumila* x *L. africana*** (Fig. 101, 102). Shown here are two more examples of this cross; the affinity to the parents is visible: Fig. 93 and 94, above, show the pale buttery yellow that can be obtained from this cross, while these two examples show the rusty apricot influence of the capsule parent. Bloom time, height, and umbel measurements are the same. Hardy in Zone 7b and they make strong statements in the garden. For the hybridizer, none of these is capsule fertile, but the pollen has not been tried.

**T. *Lycoris* x *lajolla*** (*L. africana* x *L. aurea*) (Fig. 103). Dr. Traub created the first of these hybrids, which are slightly fertile, and named them after the California city of his residence. Strong 22 to 35 in. scapes (average of 30 in.) produce 5 to 9 flowered umbels (average 6 to 7) that are 8.25 to 10.5 in. across and bloom in mid to late September. Flowers are similar appearing, but a particularly fine specimen I hybridized has the following description: 25 in. scape, light golden orange flowers, scape usually appearing first about September 12 and flowers starting bloom about September 19, umbels containing 6 to 7 flowers with a total diameter of 10.25 in., individual flower diameter 4.5 in., petal lengths 2.5 to 3 in., and segment width 5/8 in. Some flowers produce segment widths to 7/8 in.

As a group, it is somewhat tender and I cannot rate it suitable outside except in Zones 8, 9, and 10. It has a high water requirement, but is perhaps not quite as thirsty as *L. africana*, and is both needed and strikingly beautiful in the early fall garden. Both the Traub hybrids as well as my own eclipse both the parents in beauty and possibly in strength. It is altogether a fitting tribute to Dr. Traub. If you can grow it in your climate and can acquire any of the forms, it is an extraordinary *Lycoris* to showcase and will be admired for many years. It should also make a fine pot plant.

I crossed *L. aurea* back onto *L. x lajolla*, and the flowers (Fig. 104)



**Fig. 85.** *Lycoris x jacksoniana*.



**Fig. 86.** *Lycoris x jacksoniana*.



**Fig. 87.** *Lycoris x jacksoniana*.



**Fig. 88.** *Lycoris x jacksoniana*.





**Fig. 89.** *Lycoris* 'Ueki'.



**Fig. 90.** *Lycoris aurea* x *L. radiata* var. *pumila*.



**Fig. 91.** *Lycoris sprengeri* x *L. haywardii*.



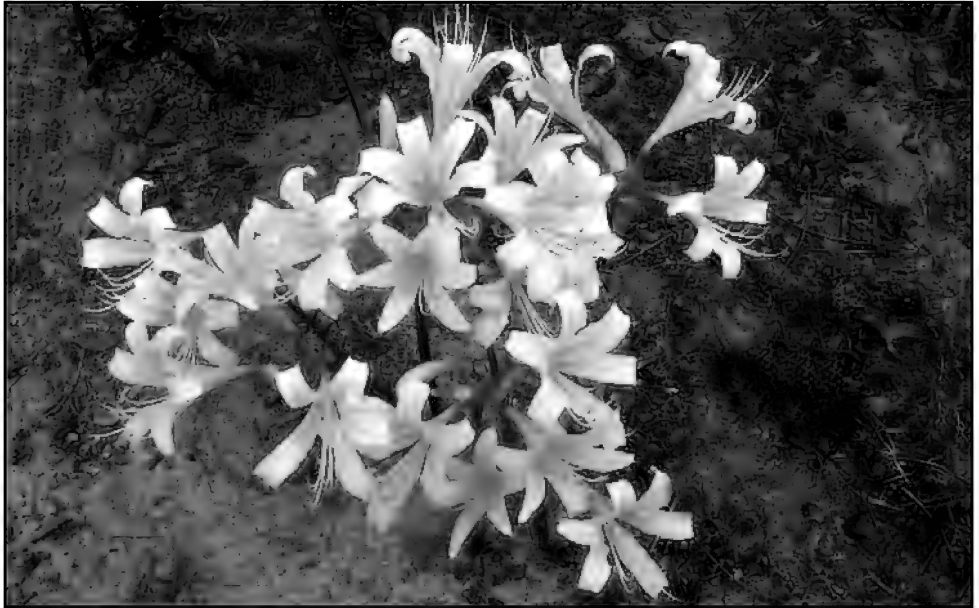
**Fig. 92.** *Lycoris africana* x *L. x haywardii*.



**Fig. 93.** *Lycoris africana* x *L. radiata* var. *pumila*.



**Fig. 94.** *Lycoris africana* x *L. radiata* var. *pumila*.



**Fig. 95.** *Lycoris sprengeri* x *L. aurea*. Photo by Nancy M. Scheiderman.



**Fig. 96.** *Lycoris sprengeri* x *L. x haywardii*.



**Fig. 97.** *Lycoris x washingtonia*.



**Fig. 98.** *Lycoris x washingtonia*.



**Fig. 99.** *Lycoris sprengeri* x *L. aurea*.



**Fig. 100.** *Lycoris* x 'Blushing Lady'. Photo by Nancy M. Scheiderman.





**Fig. 101.** *Lycoris radiata* var. *pumila* x *L. africana*.



**Fig. 102.** *Lycoris radiata* var. *pumila* x *L. africana*.





**Fig. 103.** *Lycoris x lajolla* (*L. africana* x *L. aurea*).



**Fig. 104.** (*Lycoris africana* x *L. aurea*) x *L. aurea*, a backcross of *L. aurea* onto *L. x lajolla*.

are predictably similar to both parents but have unattractive narrower petals. This hybrid does not seem to have any great advantages over the “lajolla” parent, except that it may be slightly more winter hardy. Scapes are 22 in. and umbels are an impressive 10 in. – perhaps these traits might recommend it, and it would be especially commanding in a clump.

### SOME COMPLEX CROSSES

The following *Lycoris* are hybrids in which at least one parent is already itself a hybrid. In earlier years *Lycoris* hybridizing involved crosses between one species with another. Now, since there are fertile hybrids available, more complex hybridizing can move forward with specific goals. While it is unclear where future enthusiasts will take *Lycoris* hybridizing, at least an excellent foundation of fertile hybrids is now available for use.

In these most recent hybridizing attempts, some interesting true red seedlings have emerged that are more of the tailored, funnel-form flowers rather than the spidery reds of the species. Also, several miniatures – just 60% the size of most other *Lycoris* – have made their debuts. These are just some of the exciting developments that await anyone wanting to do *Lycoris* hybridizing!

As all these have several generations of fertile parents, it should be assumed that these complex crosses are fertile both ways.

- A. (*Lycoris radiata* var. *pumila* x *L. x haywardii*) x *L. radiata* var. *pumila* (Fig. 105). A tailored red that otherwise looks like and co-blooms with its radiata parent at the end of July.
- B. *Lycoris x jacksoniana* OP (Fig. 106). A very early – late July – “Jackson” hybrid with strong magenta pink color and blue petal tips.
- C. (*Lycoris radiata* var. *pumila* x *L. x haywardii*) x (*L. radiata* var. *pumila* x *L. x haywardii*) (Fig. 107). A clear pink self showing just a hint of blue petal tips, blooming in very late July.
- D. (*Lycoris haywardii* x *L. sanguinea*) OP (Fig. 108). An elfin rusty rose red that blooms at the beginning of August and is a bit reminiscent of *L. sanguinea* var. *kiushiana*.
- E. Parentage is unknown, but it is probably (*L. radiata* var. *pumila* x *L. x haywardii*) x *L. x haywardii* (Fig. 109, 110). The best of genes have come together to create one of the finest *Lycoris* I grow. The small ink blue petal tips reflect its heritage. Always showing in August regardless of soil moisture, fertile, 15 in. scape, 6.5 in. umbel, a clear

pink self (but with a small dollop of petal tip blue), floriferous, hardy in Zone 7b, and multiplies well. This is what *Lycoris* hybridizing is about!

- F.** (*Lycoris radiata* var. *pumila* x *L. x haywardii*) x *L. radiata* var. *pumila* (Fig. 111). This backcross has produced a miniature, mostly tailored, red with cream anthers.
- G.** *Lycoris radiata* var. *pumila* x *L. x jacksoniana* and reverse (Fig. 112, 113). Here are different “Jacksons” crossed back with the capsule parent, so the resulting offspring are 75% *L. radiata* var. *pumila*. They all bloom during the first two or three weeks of August and have that, until now, elusive red or magenta-red coloring. While the species involved can hardly be surpassed in beauty, perhaps these hybrids can provide the resplendence to match! All are hardy in Zone 7b.
- H.** (*Lycoris radiata* var. *pumila* x *L. x haywardii*) x *L. radiata* var. *pumila* (Fig. 114, 115). Compare this group of backcrossed hybrids to the “Jackson” backcrosses just above. These bloom at the same time.
- I.** *Lycoris* x *jacksoniana* OP (Fig. 116, 117). All in all, the “Jackson” hybrids, just as Caldwell expected, have proven to be the more important hybrids. Those pictured bloom during the second through fourth weeks of August.
- J.** *Lycoris* x *jacksoniana* x *L. x jacksoniana* (Fig. 118, 119). The varied results are apparent in these two hybrids. They suggest that more such crosses should be made.
- K.** (*Lycoris radiata* var. *pumila* x *L. x haywardii*) x (*L. radiata* var. *pumila* x *L. x haywardii*) (Fig. 120). This is a striking tailored red that blooms during the second week of August.
- L.** (*Lycoris sprengeri* x *L. x haywardii*) x (*L. radiata* var. *pumila* x *L. x jacksoniana*) (Fig. 121). Although this is a complicated hybrid, it does not “look” much different from its “Jackson” grandparent. Still, a worthwhile garden flower that shows in the second week of August.
- M.** *Lycoris* x *jacksoniana* x (*L. x haywardii* x *L. sanguinea*) (Fig. 122). The grandparent *L. sanguinea* coupled with the grandparent *L. radiata* var. *pumila* to give a bright red flower presented on graceful scapes, blooming in the second week of August.
- N.** [(*Lycoris sprengeri* x *L. x haywardii*) x (*L. radiata* var. *pumila* x

- L. x *jacksoniana*)] OP** (Fig. 123). This true red complex hybrid is a relatively small *Lycoris* with 15 in. scapes and 6 in. umbels. Figure 124 shows another of this cross but with a brilliant magenta-pink color. Bloom for both is during the second week of August.
- O. *Lycoris* x *haywardii* x *L. x jacksoniana*** (Fig. 125). The goal here was to add more blue. While improved, more work needs doing. Blooms during the third week of August.
- P. *Lycoris radiata* var. *pumila* x (*L. x haywardii* x *L. “sperryi”*)** (Fig. 126, 127, 128). This diminutive hybrid with 16 in. scapes and 6.5 in. umbels opens during the second or third week of August with cream flowers that later become flushed with pink and then finally turn to pink. A group of these charmers is, indeed, a lift to the spirit, especially when the clump has all three color phases at once!
- Q. *Lycoris* x *jacksoniana* x (*L. radiata* var. *pumila* x *L. x haywardii*)** (Fig. 129). This is a wide-petal magenta-pink that is only 12 in. high with 5 in. umbels. Utterly charming for those who like miniatures!
- R. Parentage unknown** (Fig. 130). A bright red flower on a tiny 10 in. scape and with just 4.75 in. umbels, blooming in the fourth week of August. The parentage may be (*L. radiata* var. *pumila* x *L. x haywardii*) x [*L. africana* x (*L. x haywardii* x *L. sanguinea*)]. This parentage might produce the startling red color on an extremely short scape; but with the yellow “*africana*” as a ¼ parent, one might expect huge scapes!
- S. (*Lycoris radiata* var. *pumila* x *L. x haywardii*) x *L. aurea*** (Fig. 131). The pollen parent might suggest tenderness, but this cultivar has prospered through years of Zone 7b winters.
- T. Parentage unknown** (Fig. 132, 133). Here is Caldwell’s wonderful *Lycoris* ‘**Fawn**’. Blooms come at the very end of August or the beginning of September and thus come at a time any flowers would be welcome. It appeared in a row of *L. “sperryi”* seedlings but it is unclear what its parentage may be. Scapes are 16 in. and umbels are 7 in.. The flower form and quality should be apparent to any observer. Completely hardy in Zone 7b, free with bloom, and a fairly good multiplier. The color is reminiscent of that of a fawn.
- U. *Lycoris* x *jacksoniana* x *L. straminea* ‘**Yellow Squamigera**’** (Fig. 134). This beautiful lavender trumpet blooms the first week of September; the flower comes at least four or five weeks later than the

somewhat similar *L. squamigera*. Further, this hybrid has no yellow throat and presents in a smooth pink self. Fertile. Could one have too many of this one? (Image from the author's Zone 7b garden and made by Nancy M. Scheiderman.)

**V. (*Lycoris radiata* var. *pumila* x *L. x haywardii*) x *L. aurea* (Fig. 135).**

Not all *Lycoris* hybrids produce attractive flowers! This one looks rather like a depauperate *L. elsiae*, although it may have charms to redeem it. Blooms during the second week of September, is fertile, and withstands Zone 7b winters with impunity.

**W. As a lesson to all of us, it is important to keep good records.**

This most unusual brilliant greenish yellow *Lycoris* (Fig. 136) is supposedly a result of *L. africana* x (*L. x haywardii* x *L. sanguinea*).

A garden worker, good in almost all respects, had the habit of dragging a water hose over the *Lycoris* plantings and dislodged and lost the standard marking this one – while I was away for several months! I have since made planting charts! It withstands the Zone 7b winters, produces 7 in. umbels in mid-September, has fall emerging foliage, and sports wide segments for such a cross. Fertility is unknown.

## CLOSING COMMENTS

Several years ago I sanded the clay loam *Lycoris* beds near Memphis and also added large amounts of potash from large burn-piles available to me. The reward has been unusually good bloom on many things in July, August, and September of ensuing years. All in all, however, the most important thing that needs sorting out with *Lycoris* is how to get bloom yearly from every mature bulb. If this could be done, then all *Lycoris* would assume the position of great merit they deserve in our usually drab, lackluster, and anemic late summer gardens. As it is, blooms we obtain are vastly interesting and gorgeously colored. Appreciation of them grows, and maybe someday every home will have large and varied plantings of this jewel of the amaryllids to thrill us with their extraordinary beauty.

**All photographs by the author except where indicated**



**Fig. 105.** (*Lycoris radiata* var. *pumila* x *L. x haywardii*) x *L. radiata* var. *pumila*.



**Fig. 106.** *Lycoris x jacksoniana* OP.



**Fig. 107.** (*Lycoris radiata* var. *pumila* x *L. x haywardii*) x (*L. radiata* var. *pumila* x *L. x haywardii*).



**Fig. 108.** (*Lycoris haywardii* x *L. sanguinea*) OP.



**Fig. 109.** Probable (*Lycoris radiata* var. *pumila* x *L. x haywardii*) x *L. x haywardii*.





**Fig. 110.** Probable (*Lycoris radiata* var. *pumila* x *L. x haywardii*) x *L. x haywardii*).



**Fig. 111.** (*Lycoris radiata* var. *pumila* x *L. x haywardii*) x *L. radiata* var. *pumila*).



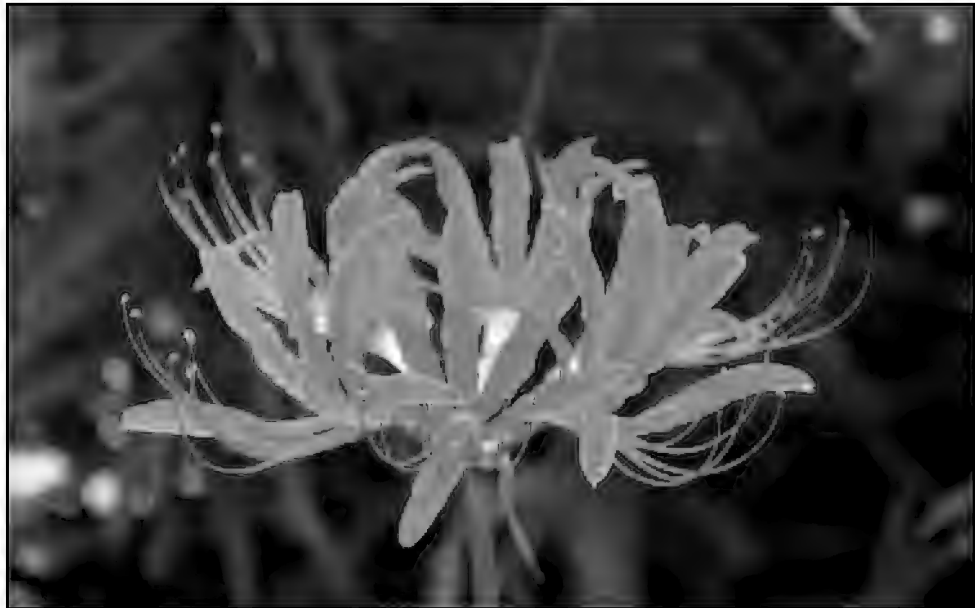
**Fig. 112.** *Lycoris radiata* var. *pumila* x *L. x jacksoniana*.



**Fig. 113.** *Lycoris radiata* var. *pumila* x *L. x jacksoniana*.



**Fig. 114.** (*Lycoris radiata* var. *pumila* x *L. x haywardii*) x *L. radiata* var. *pumila*.



**Fig. 115.** (*Lycoris radiata* var. *pumila* x *L. x haywardii*) x *L. radiata* var. *pumila*.



**Fig. 116.** *Lycoris x jacksoniana* OP.



**Fig. 117.** *Lycoris x jacksoniana* OP.



**Fig. 118.** *Lycoris x jacksoniana* x *L. x jacksoniana*.



**Fig. 119.** *Lycoris x jacksoniana* x *L. x jacksoniana*.



**Fig. 120.** (*Lycoris radiata* var. *pumila* x *L. x haywardii*) x (*L. radiata* var. *pumila* x *L. x haywardii*).



**Fig. 121.** (*Lycoris sprengeri* x *L. x haywardii*) x (*L. radiata* var. *pumila* x *L. x jacksoniana*).



**Fig. 122.** *Lycoris x jacksoniana* x (*L. x haywardii* x *L. sanguinea*).



**Fig. 123.** [(*Lycoris sprengeri* x *L. x haywardii*) x (*L. radiata* var. *pumila* x *L. x jacksoniana*)] OP.



**Fig. 124.** [(*Lycoris sprengeri* x *L. x haywardii*) x (*L. radiata* var. *pumila* x *L. x jacksoniana*)] OP.





**Fig. 125.** *Lycoris* x *haywardii* x *L. x jacksoniana*.



**Fig. 126.** *Lycoris radiata* var. *pumila* x (*L. x haywardii* x *L. "sperryi"*).



**Fig. 127.** *Lycoris radiata* var. *pumila* x (*L* x *haywardii* x *L* "sperryi") with flowers beginning to show a pink flush with age.



**Fig. 128.** *Lycoris radiata* var. *pumila* x (*L* x *haywardii* x *L* "sperryi") with older flowers that have now turned pink.



**Fig. 129.** *Lycoris x jacksoniana* x (*L. radiata* var. *pumila* x *L. x haywardii*).



**Fig. 130.** Possible parentage of this hybrid is (*L. radiata* var. *pumila* x *L. x haywardii*) x [*L. africana* x (*L. x haywardii* x *L. sanguinea*)].



**Fig. 131.** (*Lycoris radiata* var. *pumila* x *L. x haywardii*) x *L. aurea*.



**Fig. 132.** *Lycoris* 'Fawn'.



**Fig. 133.** *Lycoris* 'Fawn'.



**Fig. 134.** *Lycoris* x *jacksoniana* x *L. straminea* 'Yellow Squamigera'. Photo by Nancy M. Scheiderman.



**Fig. 135.** (*Lycoris radiata* var. *pumila* x *L. x haywardii*) x *L. aurea*.



**Fig. 136.** Supposed hybrid between *L. africana* x (*L. x haywardii* x *L. sanguinea*).

## THE GENUS *HAEMANTHUS* L. (AMARYLLIDACEAE) – A PERSONAL ACCOUNT OF MY RELATIONSHIP WITH THESE FASCINATING PLANTS

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I am not a botanist and make no pretence that this account of my interaction with *Haemanthus* is anything more than my personal experiences and opinions. Exploring and recording wild flowers in South Africa has been a lifetime interest and activity. In my earlier years I concentrated chiefly on the Eastern summer rainfall region where I lived but in later life my wife, Rhoda, and I moved to the Western Cape which opened up for me the new and fascinating field of winter rainfall flora. Initially my interest in wild flowers, and particularly wild bulbs, was very much a hobby, but later Rhoda and I developed a Wild Bulb Nursery and still later, as a result of a demand from our many clients throughout the world, we started arranging botanical tours which proved to be very popular.

Amaryllidaceae are amongst my favourite wild flowers - a family that is particularly well represented in South Africa. *Cyrtanthus*, *Nerine* and *Haemanthus* have always been my main focus. My career as a sheep and wool consultant took me to many outlying farms and afforded me the opportunity to explore the grasslands, krantzes and thickets where these plants occur. My first encounter with *Haemanthus* very early on in my career was on a farm in the Cathcart district where, having stopped for lunch during a day of sheep classing, I spied some small pink brush-type flowers clinging to a steep cliff – later to be identified as *Haemanthus humilis*. I was immediately hooked on these plants and started growing them. I discovered that this species is extremely variable in size, flower colour and flowering time, and mostly confined to steep cliffs and rocky outcrops where they thrive in rock cracks. Looking for other species and new populations and variations in populations became a life long passion.

Confined to South Africa and Namibia, the 22 known *Haemanthus* species are fleshy, often hairy plants, well known for their characteristically compact, brush-like inflorescences. Their specialised fruits are berries

which contain a few large, moisture-rich seeds. Bulbs of *Haemanthus* were amongst the first plants gathered at the Cape and subsequently cultivated in the gardens of Europe. The earliest known description appeared in 1605 where plants (probably *H. coccineus* and *H. sanguineus*) were given the phrase name *Narcissus Africanus sive Narcissus exoticus*. The name *Haemanthus* was first proposed by Hermann in 1687 and thereafter appeared in many publications as *Haemanthus africanus*. Baker published a taxonomic treatment of *Haemanthus* in *Flora Capensis* (1896), which included *Scadoxus*. In a brief review of the genus by Friis and Nordal in 1976, the generic limits of *Haemanthus* were amended and the genus *Scadoxus* reinstated. As presently circumscribed, *Haemanthus* includes only species with true bulbs, distichous fleshy leaves and a chromosome complement of 16.

In 1991 I acquired a copy of Dr. Deirdré Snijman's "A revision of the genus *Haemanthus* L. (Amaryllidaceae), a comprehensive taxonomic treatment of *Haemanthus*, published in 1984 (*Journal of South African Botany*, Supplementary Volume No. 12), from which much of the information in this introduction is taken. There are 21 species in this revision and subsequently an additional species was described in 1993 (*Haemanthus pauculifolius*). This publication, now long out of print, proved invaluable as a handbook. Later I was privileged to meet Dr. Snijman and we became firm friends, regularly exchanging information and sometimes going on excursions together.

Of the 22 species, 14 occur exclusively in the winter rainfall region with a concentration of species in the dry Namaqualand region of the North West Cape. Six species occur exclusively in the summer rainfall region, and there are two species which overlap into both regions, namely *H. coccineus* which has the widest range extending from Namaqualand to the Keiskamma River in the Eastern Cape and *H. albiflos* which is a summer rainfall species, extending as far west as Still Bay in the winter rainfall region.

Most species produce two leaves each year. The shape, pubescence, markings and orientation are valuable taxonomically. In the evergreen species *H. albiflos* and *H. deformis*, leaves sometimes persist beyond a year, resulting in 4 to 6 visible leaves. The majority of individuals of *H. unifolius* and *H. nortieri* and *H. pauculifolius* have only a solitary leaf, but in the latter species, being evergreen, the leaf sometimes persists and then the plant exhibits two leaves. *Haemanthus* flowers are borne in an



umbel surrounded by membranous to fleshy spathe valves, the position, number and texture being taxonomically important. The fruit is a globose to elliptical berry which when ripe is soft, pulpy and often translucent varying in colour – white, yellow, orange, red and various shades of pink, depending on the species. The seeds are succulent, smooth and greenish-white to wine red.

Dr. Snijman, in her article “What makes Southern Africa’s *Amaryllidaceae* special” in the IBSA Bulletin No. 42 (1994), describes the seed dispersal as follows: “When in fruit the scape of *Haemanthus* elongates and gradually flops to the ground. The funicle which holds the seed to the fruit wall produces copious mucilage, aiding germination by protecting the seed from desiccation. This mode of dispersal is thought to be one in which the seeds are shed in “safe-sites”, namely patches close to the parents’ suitable habitat. This strategy maximises the suitability of the niche in which the seed is deposited which in turn maximises seedling survival. However, the species’ ability to spread is limited.” It was always a puzzle to me how plants of *H. humilis* could become established on almost vertical places between the rock strata on cliffs where they grow. When handling ripe seed, I soon realised that this is due to fact that the seeds are connected to sticky threads that enable them to adhere to virtually any surface and, under favourable conditions they become rooted seedlings. This feature is probably common to other cliff growing species of *Haemanthus*.

Dr. Snijman has classified *Haemanthus* into four groups of closely allied species:

*H. humilis* group

- |                                 |                                  |
|---------------------------------|----------------------------------|
| 1. <i>H. humilis</i> Jacq.      | 3. <i>H. montanus</i> Baker      |
| 2. <i>H. carneus</i> Ker Gawler | 4. <i>H. avasmontanus</i> Dinter |

*H. crispus* group

- |                               |                                    |
|-------------------------------|------------------------------------|
| 5. <i>H. crispus</i> Snijman  | 7. <i>H. tristis</i> Snijman       |
| 6. <i>H. barkerae</i> Snijman | 8. <i>H. namaquensis</i> R.A. Dyer |

*H. albiflos* group

- |                                |                                     |
|--------------------------------|-------------------------------------|
| 9. <i>H. albiflos</i> Jacq.    | 11. <i>H. pauculifolius</i> Snijman |
| 10. <i>H. deformis</i> Hook f. |                                     |

*H. coccineus* group

- |                                    |                                   |
|------------------------------------|-----------------------------------|
| 12. <i>H. sanguineus</i> Jacq.     | 18. <i>H. nortieri</i> Isaac      |
| 13. <i>H. canaliculatus</i> Levyns | 19. <i>H. coccineus</i> L.        |
| 14. <i>H. pumilio</i> Jacq.        | 20. <i>H. dasyphyllus</i> Snijman |
| 15. <i>H. lanceifolius</i> Jacq.   | 21. <i>H. unifolius</i> Snijman   |
| 16. <i>H. amarylloides</i> Jacq.   | 22. <i>H. pubescens</i> L.f.      |
| 17. <i>H. graniticus</i> Snijman   |                                   |

The *Haemanthus humilis* group, which are summer rainfall species, flower from mid summer. *Haemanthus avasmontanus* is known from the type specimens only, collected from the Augsburg, south east of Windhoek in central Namibia in 1923 (See also Craib, *Herbertia* 64:67-90, 2010). The winter rainfall species, which include both the *H. crispus* and *H. coccineus* groups flower in autumn. A number of species in the winter rainfall region are locally endemic and under considerable threat. The most notable of these are *H. tristis*, *H. canaliculatus*, *H. pumilio* and *H. lanceifolius*. The *H. albiflos* group is evergreen and flowers in winter or early spring.

**THE SUMMER RAINFALL SPECIES**

My personal experience with *Haemanthus* is confined largely to the summer rainfall species, and more specifically to those which occur in the Eastern Cape. I have been fascinated by the variability of local populations, particularly of the *H. humilis humilis* group which occurs over a wide range of habitats. It is widespread but occurs in isolated and localised populations, always in rocky habitats. Populations near Satan's Nek and Rhodes in the North Eastern Cape are the earliest to flower in December. I have observed them in really high altitude habitats near the Melatsunyane Falls, Semonkong, Lesotho. Further north the subspecies *Haemanthus humilis hirsutus* is dominant, characterised by hairy stems and leaves and very long stamens.

The most spectacular form of *H. humilis* is one we call "Giant" which we observed through binoculars growing on a steep cliff in full shade on the opposite bank of the Great Kei River east of Stutterheim. I had to swim the river and scale the cliff to obtain seed, and now I have a well established population in the nursery. It has leaves as large as 60cm in diameter and it has an enormous flower head. In sharp contrast is a miniature form growing near King Williams Town with tiny flower heads on stems less



**Fig. 1.** *Haemanthus humilis humilis* from Rhodes flowering in December in a typical rocky habitat.



**Fig. 2.** *Haemanthus humilis humilis* - a white form from the Kei Valley near Stutterheim.



**Fig. 3.** *Haemanthus humilis humilis* - a beautiful dark form from the Karoo growing near the Compassberg, Nieu Bethesda.



**Fig. 4.** *Haemanthus humilis humilis* - a dwarf form scarcely 20cm high from near King Williams Town.



**Fig. 5.** *Haemanthus humilis humilis* - the giant form with flower heads 20cm in diam. and leaves as large as chair seats - originating from south facing cliffs in the Great Kei River Valley.



**Fig. 6.** *Haemanthus humilis hirsutus* - the northern subspecies of *H. humilis* with exceptionally long stamens.



**Fig. 7.** *Haemanthus carneus* from the Bosberg, Somerset East - note the inserted stamens.

than 20cm in height, which we call “Dwarf”. Two other noteworthy variations of *H. humilis* in the Eastern Cape are an early flowering form from the Graaff Reinet area of the central Karoo. This form has small cerise flowers with bright yellow stamens – very, very attractive. A white form with pubescent leaves growing in Acacia thicket in the Stutterheim district is another interesting form.

Closely allied to *H. humilis* is the enigmatic *H. carneus*, known from only a very few disjunct populations. This rare species flowers in January and is distinguished by a looser, widely spreading umbel, and stamens included well within the perianth, the only known *Haemanthus* with this feature. It has the same growth pattern as *H. humilis*, with leaves emerging just after the flowers and persisting until late spring. It occurs in Acacia thicket and grassland from the base to the top of the Bosberg Mountain near Somerset East. One wonders whether *H. carneus* should be considered separate from *H. humilis* on the basis of the small difference mentioned above. However one clear difference between the two species is the colour of the developing and ripe seed capsules: *H. carneus* always being reddish pink and *H. humilis* orange-yellow. What confuses the issue is a further

form which occurs some 40km further west on Bruintjieshoogte, which has stamens the same length as the perianth tube, a feature shared by the white form of *H. humilis* from Stutterheim mentioned above. These seem to be intermediate between *H. carneus* and *H. humilis*. Isolated populations of *Haemanthus* with included stamens occurring near Escourt in Natal and near Jagersfontein in the Free State, have been attributed to *H. carneus*. Charles Craib writing in IBSA Bulletin No. 48 (1999) with the same reservation queried this distinction, basing his query on the fact that populations of *H. carneus* and *H. humilis hirsutus* occur near to each other in identical habitats near Estcourt. Dr. Snijman, commenting in the same publication suggested that the shorter stamens of *H. carneus* could be an adaptation to exploit a different pollinator to *H. humilis*, and that should this be the case, it is possible that two taxonomic entities might be reproductively isolated in the wild – despite their shared physical habitats and close geographic proximity to one another.

My breath was almost taken away when I first observed a small patch of flowering *Haemanthus montanus* near the roadside in the Bedford district of the Eastern Cape. Why does it occur in such small and isolated populations? The reason is that it is adapted to small areas of seasonally wet, poorly drained shallow soil with an impervious substratum. It completes its annual cycle in four to five months, the period during which its fairly hostile habitat remains moist. It occurs in dense stands, the large cream flowers appearing in January, rapidly followed by two upright leaves. The seeds ripen by mid-February and germinate rapidly around the parent plants. The leaves dry off and blow away by the end of May when all signs of the bulb population vanish. The Bedford district is probably the most southern extremity for this species. I have also observed them in wetlands in the Eastern Free State and here the plants tend to be taller and more robust



Fig. 8. Massed blooming of *Haemanthus montanus* near Bedford.



**Fig. 9.** *Haemanthus montanus* flowering near Thomas River in November - one of the earliest *Haemanthus* to flower.



**Fig. 10.** *Haemanthus albiflos* in a forest habitat. It has forms that are adapted to a wide range of habitats.



with much larger seeds. I searched for some years for the population once recorded along the Cathcart/Hogsback road, eventually discovering a few plants and later another population a little further south near Thomas River. These two populations are very small and threatened by habitat destruction. Interestingly, they flower in late November and December, a full month earlier than the Bedford populations.

The most widespread *Haemanthus* in the Eastern Cape is *H. albiflos* which is amazingly adaptive and versatile in its habitat. It is a particularly desirable and easy to grow garden subject and is also suitable as a ground cover in shady areas. It is equally at home in deep shade on forest floors, on rocky sea shores exposed to salt spray, in coastal dune forest, in thicket in the Fish River valley, on cliff faces in hot river valleys where it clings in large clumps to crevasses in full sun, and in shady places on high altitude inland mountain ranges. The form that occurs on exposed north facing cliffs in full sun in the Stutterheim district is particularly interesting as, in adapting to this harsh environment, it has developed thick leathery greyish leaves, much smaller than the usual form that grows in shade. *Haemanthus albiflos* is evergreen and multiplies vegetatively, as well as from seed. The attractive white flowers appear in May and June and the ripe seeds are carried in most attractive clusters of scarlet fruit.

The other two evergreen species are *H. deformis* and *H. pauculifolius*. The former occurs in the Natal midlands and coastal areas and is characterised by two large flat leaves and flowers with large white green-



Fig. 11 *Haemanthus deformis*.



Fig. 12 *Haemanthus pauculifolius*.

striped bracts born on very short stems. *Haemanthus pauculifolius* has only one leaf, but since it is evergreen and the leaf persists it may exhibit two. Similar to *H. albiflos*, this species also produces photosynthetic bulbs that often position themselves to grow atop the surface of the growing medium. Because it is a later described (1993) summer rainfall species, it is the only one not listed in the 1984 revision. I have not observed either of these species in the wild, but I have grown them successfully.

### THE WINTER RAINFALL SPECIES

Rhoda and I moved to Napier in the South Western Cape a number of years ago, and for the first time I was exposed to the magnificent winter rainfall flora which included a wide variety of *Amaryllidaceae*. *Haemanthus coccineus* and *H. sanguineus* were the first two I encountered, both widespread in the region where we live flowering in January and February. I was familiar with *H. coccineus*, having observed it as far east as the Keiskamma River valley near Hamburg, East Cape (where it grows here in Valley Thicket vegetation together with a small form of *H. albiflos* which flowers in winter, so they don't hybridize). I was amazed to find this winter rainfall species so far east, where it retains its typical growth and flowering pattern. I have also observed it far inland in the rather arid Karoo north of the Zuurberg in the Somerset East district. *Haemanthus coccineus* occurs from here, a summer rainfall region, westwards through the winter rainfall region of the Western Cape and up to the arid regions of Namaqualand and Namibia, an enormous range of 2000+ kilometers and climate variation! It prefers clay soils derived from shale. Flower stems can be reddish, or blotched with red, and the leaves have varying degrees of stripes and dots on the underside.

Both *H. coccineus* and *H. sanguineus* have very similar flowers and occur in the same habitats although the latter can also occur in acidic sandy fynbos soils. They are only easily distinguishable by the leaves, and since they bloom before leaves emerge, it is sometimes a puzzle to be sure of the species at the flowering stage. In contrast to *H. coccineus* which has softer more upright leaves, *H. sanguineus* has tough, leathery leaves, rounder in shape with a distinct reddish margin and always flat on the ground, and no markings on the underside of the leaves.

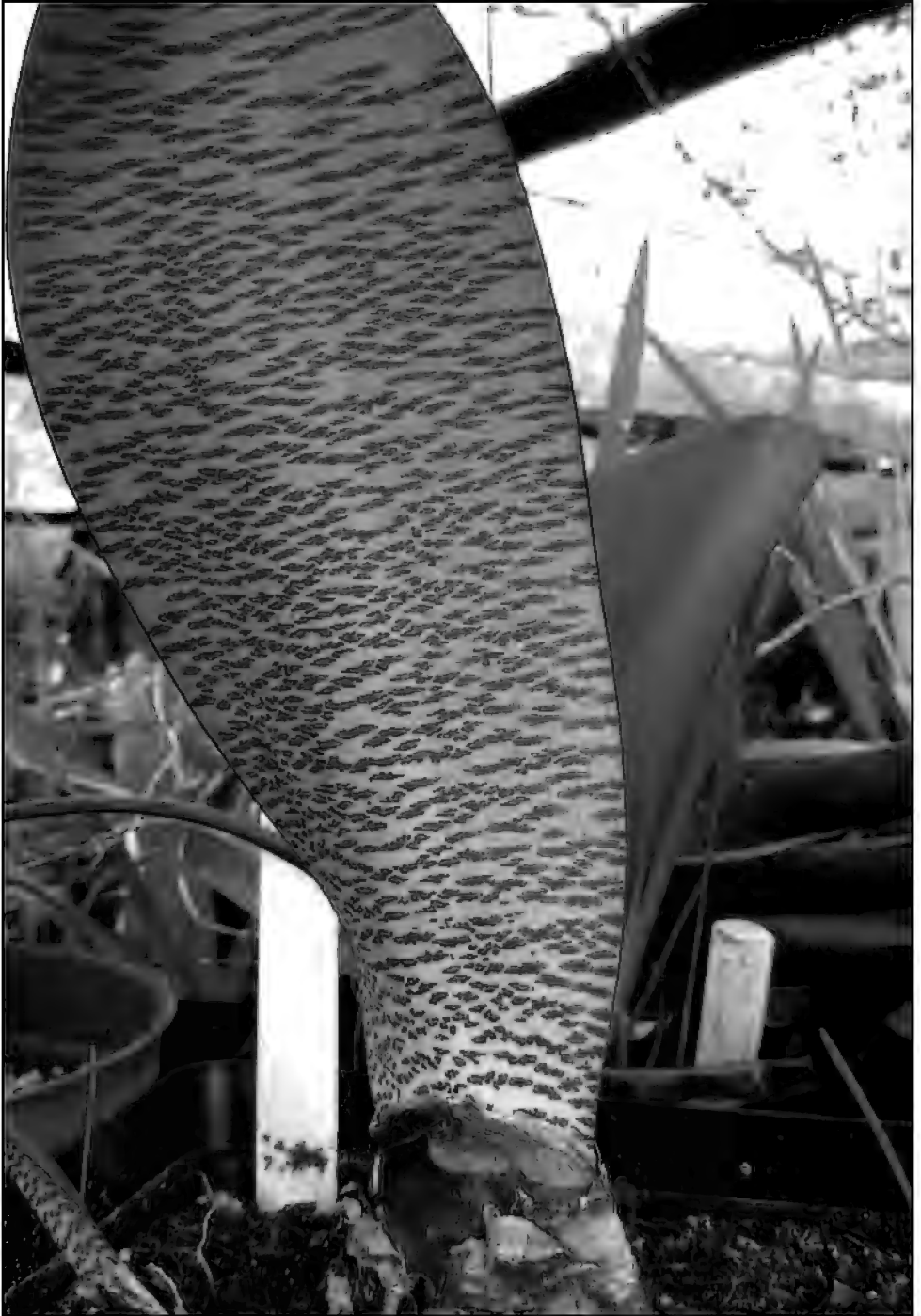
A rare local endemic, *Haemanthus cananiculatus* occurs at a seaside village, Betty's Bay not far from where we live. Generally very shy to flower



**Fig. 13.** *Haemanthus coccineus* growing in coastal dune grassland at Cape Agulhas, the southernmost tip of Africa.



**Fig. 14.** *Haemanthus coccineus* growing in a shale scree in the DeHoop Nature Reserve, West Cape.



**Fig. 15.** *Haemanthus coccineus* leaf. The typical underside markings on a plant from Colchester near Port Elizabeth in the Eastern Cape.



**Fig. 16.** *Haemanthus sanguineus* leaves. While the flowers are very similar to *H. coccineus*, this species is easily identified by its leaves.



**Fig. 17.** *Haemanthus canaliculatus* - a very localised species confined to Betty's Bay, on the Cape south west coast. Note the narrow leaf.

unless stimulated by a fire, there are few residents in the village who have populations on their properties and clear the vegetation providing open sunny conditions to encourage regular flowering, affording people like ourselves the opportunity to view this rare species which occurs nowhere else. The narrow spotted upright leaves are rather unique in the genus.

There are a number of rare endemics up the West Coast and in Namaqualand which are rarely seen. While we grow and flower some of them, this is not the same as observing them in the wild. I have conducted a number of botanical tours in Namaqualand but always in the spring at the height of the famous wild flower displays. If we are lucky we sometimes come across the foliage of species like *Haemanthus unifolius*, *H. graniticus* and *H. crispus* without having seen the flowers.

Species we have grown and flowered in our nursery include *H. pubescens* and *H. nortieri*. The latter is one of the very rarest of the *Haemanthus*. It grows in sandy soils between rock sheets. It has one leathery upright leaf which is rough and sticky. In hot and dry conditions soil sticks to the leaf surface which helps to protect the leaf from desiccation. The flower head is bright red with bright red with bright yellow stamens.

Our son-in-law has a farm in the middle of the arid Ceres Karoo where *Haemanthus tristis* occurs. Consequently this is one rare endemic with which we are familiar and which we have observed at close quarters. The Ceres Karoo has an average annual rainfall approximately 100mm, falling mostly in winter. *Haemanthus tristis* flowers in exposed places in full sun in February at the height of the torrid dry summer. It occurs mainly in sandy places with a clay substrate. The bulbs sit in the sand while the roots penetrate deep into underlying clay which is moisture retentive. The pale lemon yellow flowers soon fade and produce large purple seed capsules in which the large seeds are enclosed in a thick leathery membrane. These specialised seeds are adapted to fall and survive the weeks and months before rain finally falls in early winter when they have a chance to germinate. Two grey-green upright leaves appear shortly after flowering and persist through the winter.

#### PROPAGATION

*Haemanthus* are easy to propagate from seed. Seed will germinate soon after ripening but germination can be retarded by keeping it in a fridge.



**Fig. 18.** *Haemanthus nortieri* in leaf.





**Fig. 19.** *Haemanthus nortieri* in flower - same bulb as Figure 18.





**Fig. 20.** *Haemantus tristis* - a rare endemic from the arid Ceres Karoo.



**Fig. 21.** *Haemantus tristis* - seeds are enclosed in a thick leathery membrane. These specialised seeds are adapted to fall and survive the weeks and months before rain finally falls in early winter when they have a chance to germinate.



**Fig. 22.** *Haemantus tristis*. Two grey-green upright leaves appear shortly after flowering and persist through the winter.

Sowing seed is easiest after a radicle has formed, when they can be placed in rows in a seed box of well drained seedling mix with the radicle in the soil and the seed on the surface. Water sparingly but do not allow the seed box to dry out. Leaves form rapidly. Most species retain their leaves for the first year. Seedling bulbs can be kept in seed boxes for a year or two after which they should be transferred to individual containers. The secret is well drained soil. Winter rainfall species should be kept moderately dry in summer. Summer rainfall species are more tolerant of watering all year round and should not be allowed to dry out completely in their dormant phase. Evergreen species should be kept moist all year round. Species from high altitudes such as *H. humilis*, *H. carneus* and *H. montanus* should be fairly hardy and are able to tolerate 5 to 6C degrees of frost.

We have found *H. albiflos*, *H. coccineus* and *H. humilis* "Giant" the easiest to propagate and the fastest growers. While not difficult to cultivate, other species are slower to develop. The wonderful flowers that are eventually produced are ample reward for patience and care in growing them.

**All photographs by the author**

## THE STATUS OF *CRINUM FLACCIDUM* AND *CRINUM LUTEOLUM*

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“Nature looks quite refreshed; the grass is so green, and the modest blue *Ruellia* so plentiful; whole fields of *Crinum* are in full blossom; and the Ironbark and flooded-gum with a denser and richer foliage than usual, afford us a most agreeable shade. I wish I could sufficiently describe the loveliness of the morning just before and after sunrise: the air so clear, so transparent; the sky slightly tinged with roseate hues, all nature so fresh, so calm, so cool.”

Ludwig Leichhardt, Australian Explorer and Naturalist, 1848

### INTRODUCTION

The most recent review of Australian Amaryllidaceae was undertaken in the Flora of Australia by H.J. Hewson (1987), a systematic botanist. His treatment of the genus *Crinum* was stated to be conservative due to the limitations of interpreting herbarium specimens when there were species that had a range of eco-variants. Hewson concluded that the genus *Crinum* in Australia required a monographic revision, as it was in a state of taxonomic confusion. He stated: “In the absence of field work and a thorough revision, a conservative approach was adapted in the hope of providing a broad but sound basis for further research.” He pointed to the relative unstable genetic expression in some populations of Australian *Crinum* possibly due to hybridization between stranded populations of co-variants that were recognizable in the field but not in herbaria.

Prior to this 1987 revision it was considered that there were at least 12 endemic *Crinum* species in Australia. The Australian *Crinum* species recognized by Hewson were reduced to five: *C. pedunculatum*, *C. flaccidum*, *C. uniflorum*, *C. angustifolium* and *C. venosum*. He hence reduced to synonyms a number of species that he regarded as *C. flaccidum* eco-variants. These were previously described as species such as *C. luteolum*, *C. brisbanicum*, *C. pestilensis* and *C. brevistylum*. To this list could be added the as yet formally undescribed Lower Murray River *Crinum* mentioned by

Les Hannibal as a significant variant of *C. flaccidum*.

In this article I will be comparing the distinctive features of a few of the likely eco-variants within the *C. flaccidum* complex and in particular comparing the type form of *C. flaccidum* with the yellow flowered variant that was known as *C. luteolum*, and what appears to be a desert eco-variant of *C. luteolum*. To further indicate the complexity of the species *C. flaccidum*, the white flowered variant found growing around the Lower Murray River in South Australia appears to be a polyploidal variant.

There are many factors that are attributed to fostering the evolution of new species; one of them is the eco-variant model where a species growing in different ecological habitats will develop a range of physiological responses and related phenotypic changes over time. Another factor creating change is that of polyploidy. In 2004 I sent leaf cuttings of a number of Australian *Crinum* species and *C. flaccidum* variants to Ben J.M. Zonneveld of the National Herbarium Netherlands for analysis. He tested each leaf sample using flow cytometry for a measure of the total amount of nuclear DNA in the nucleus of each leaf cell, thus determining the ploidy of *C. flaccidum* and its variants. The conclusion was that the type form of *C. flaccidum* and the variant called *C. luteolum* were diploids  $N=2$ , while the Lower Murray *C. flaccidum* variant populations were hexaploids, and the *C. brisbanicum* variant found in SE Queensland was a tetraploid taxa. These distinctions in ploidy provide an additional indication of the genetic separation from *C. flaccidum* that is occurring in these variant populations.

A thorough coverage of three field trips to explore these *C. flaccidum* species and variants has been provided by Rob Hamilton (2007, 2008, 2010), with his chronicles including numerous colour photographs.

#### THE TYPE FORM OF *CRINUM FLACCIDUM* HERBERT

In order to appreciate the way in which *C. flaccidum* differs from *C. luteolum*, it is necessary that we consider the colonies from which the type form of *C. flaccidum* was initially described. I became an admirer of the sweet spicy scented *C. flaccidum* from the most easterly populations in the Wellington and Quirindi regions in the NSW Central Tablelands ever since I first saw it flowering in the thousands amongst the conglomerate boulder-strewn escarpment of Mt. Arthur. This is the region from which the isotype of *C. flaccidum* was collected in 1817 during an expedition by John Oxley who was exploring the catchments and country around the Lachlan and Macquarie



**Fig. 1.** *Crinum flaccidum*. Macquarie Crinum. Curtis's Botanical Magazine Vol 47, t.2133, 1820.

Rivers in New South Wales for land suitable for agriculture.

After being blocked by reeds in his exploration of the Lachlan River, John Oxley headed north-east and then traveled back down the Macquarie River to Bathurst. From his description of the mountains and valley he named on that journey, he appears to have looked down upon what he named the Wellington Valley – upon which is the site of Wellington township. I believe that it was likely to have been on this leg of the journey that bulbs of the type form of *C. flaccidum* were initially collected. William Herbert briefly described *C. flaccidum* in 1820 from the lectotype found near the Macquarie River which flowered in Kew, this account being published in his *Specierum Enumeratio* which accompanied his presentation of *Crinum broussoneti* in t.2121 in Curtis's Botanical Magazine. Herbert expanded his description to accompany Sims's (1820) account of *C. flaccidum* which included the first illustration in t.2133 in Curtis's Botanical Magazine. Sims commented: "The *Crinum flaccidum* is a native of New Holland and was discovered on the same expedition that produced the purple and yellow *Calostemma*'s before published under the Macquarie Range ..."

Les Hannibal (1963) questioned the accuracy of the illustration as he thought that the flower form was too broadly petaled and that this distortion may have been caused by its cultivation in a glass house. He was concerned that Herbert had erroneously assigned *C. flaccidum* to the subgenus *Codonocrinum* – however, the lectotype (from around the Macquarie River catchment) in the excellent Botanical Magazine illustration from 1820 (t.2133, Fig. 1) had bent tepal tubes, broad flower segments, and filaments brought close together so that they were nearly parallel with one another, whereas Hannibal thought *C. flaccidum* possessed thin segmented flowers, straight tepal tubes and spreading filaments as found in subgenus *Platyaster* represented in Australia by *C. angustifolium*, this being in line with Hannibal's concept of *C. flaccidum* as a highly variable polymorphic species. In fact Hannibal (1970-71) later became adamant that *C. flaccidum* belonged to subgenus *Platyaster*. However, from my first hand experience of seeing thousands of *C. flaccidum* bulbs in bloom in the district around Wellington and the western flood plains of NSW, I can verify that t.2133 is a fine illustration of a typical *C. flaccidum* flower form – subgenus *Codonocrinum* – given that within this broad population there is variation in flower segment shape.



**Fig. 2.** *Crinum flaccidum*, Macquarie form with broad rounded tepals, March 13, 2004.



**Fig. 3.** *Crinum flaccidum* from marsh habitat at Dubbo, New South Wales, February 8, 2009.



**Fig. 4.** *Crinum flaccidum* with rose coloured flower buds, Gilgandra, New South Wales, March 1, 2008.



**Fig. 5.** Pink *Crinum flaccidum* flower with magenta flower buds in the background, from Wellington, New South Wales, February 7, 2004.





**Fig. 6.** Broad petaled form of *Crinum flaccidum*, Dubbo, New South Wales, March 1, 2008.



**Fig. 7.** Broad petaled form of *Crinum flaccidum* from Wellington, NSW February 11, 2004.



**Fig. 8.** Lower Murray River variant of *Crinum flaccidum* from Calpernum, South Australia, March 1, 2009.



**Fig. 9.** Alluvial sand habitat of Lower Murray River variant of *Crinum flaccidum*, South Australia, February 14, 2007.



**Fig. 10.** *Crinum flaccidum* variant previously named *Crinum brisbanicum* with characteristic subulate-lanceolate tepals and bright pink stamens and stigma, Goondiwindi, New South Wales, February 27, 2008.



**Fig. 11.** Presumed *Crinum flaccidum* variant previously named *Crinum brisbanicum* displaying long linear tepals, long pedicels and scabrous leaf edges, near Surat, South Queensland, February 28, 2008.

While lanceolate, deltoid, spathulate or elliptical tepal flower forms are to be found in *C. flaccidum* colonies, the majority of mature plants tend to have flowers with rounded and broader tepals as represented in the Curtis illustration. There is another floral feature that can be found in every population of *C. flaccidum* that I have examined; a significant proportion of *C. flaccidum* plants from the lectotype region have soft pink tepal pigmentation with a darker reverse. This is present to a smaller extent in all the flood plain populations of *C. flaccidum*. Another distinctive colour feature of *C. flaccidum* is that its scapes are pigmented with either rose, burgundy, green, bronze or pink pigments even when carrying white flowers with green pedicles. Neither of these colour features appears on any of the eco- or polyploidal variants of *C. flaccidum*.

The geographical variants of *C. flaccidum* are found over the vast interior of the Australian mainland, and at least one eco-variant can be found in every mainland state. They are locally known by names such as the Darling lily, Murray lily, Macquarie lily, Desert lily, Bogan lily, Sandover lily, Pardoo lily, and Andamooka lily.

The *C. flaccidum* populations responsible for the major lines of seed distribution are found in the headwaters of river systems on the western side of the Great Dividing Range in New South Wales and Southwest Queensland. These rivers are known as the Macquarie, Barwon, Lachlan, Namoi, Bogan, and the Castlereagh. They flow west or southwest, toward the arid interior of Australia joining together to form the Darling-Murray River which is around 2,740 kilometers in length and fed by a basin of 1,061,469 sq. kilometers. In the headwaters of these water catchment basins are isolated populations of *C. flaccidum* that may display variances from the type form in flower shape and floral characteristics. However, they remain distinctive as the spectrum of flowers constituting *C. flaccidum*. In major flood periods, seeds of these regional stranded colonies of *C. flaccidum* may be swept westward over the flood plains into the channels, marshes, lakes and wetlands that are part of the Darling/Murray Rivers – however, even after major flood events in Queensland and Northern NSW, it still takes almost a year for the flood waters to fill the lakes, marshes and wetlands along its length as the landform is particularly shallow.

#### STATUS OF *CRINUM LUTEOLUM* TRAUB & HANNIBAL

The taxonomic status of *Crinum luteolum* remains unresolved, but I



**Fig. 12.** *Crinum luteolum* from Pichi Richi Pass north of Port Augusta, South Australia, February 3, 2002.



**Fig. 13.** Salt bush habitat of *Crinum luteolum*, Pichi Richi Pass north of Port Augusta, South Australia, February 15, 2007. Numerous scapes in foreground are post blooming and are in active seed formation.

understand there are recommendations to reinstate it as a distinct species. It was initially described in a brief account published in *Herbertia* by Traub & Hannibal in 1965 from bulbs collected at Pichi Richi Pass by W. Morris, in the Southern Flinders Ranges, near Port Augusta, in South Australia, and then Traub (1966) provided an expanded emended description in *Herbertia* the following year. Traub made his observations from bulbs of this *C. luteolum* collection that flowered in three California gardens. Earlier Hannibal (1963) in consultation with David Symon (Australian systematic botanist) and then Higginson & Hannibal (1964) had written about the four variants of *C. flaccidum* throughout Australia, and they had concluded that there were insufficient differences to consider the Pichi Richi yellow form as a distinct species even though they wrote that the blossoms of the Pichi Richi form were: "... about 60% of the size of the type, have a quite pronounced elliptical tepal segment pattern, are prone to be patent with widely spreading anthers; and are inclined to develop a curvature to the tepal tube during the heat of the day. But the most distinctive of all features is the phototropic behavior of the scape and umbel which tends to face all the blooms into the sun and turn like a sunflower. This particular behavior is not present in the other (*flaccidum*) forms which tend to distribute the individual blossoms radially in the umbel and not track the sun..." They described five more differences in the filaments, style, blossom longevity, number of blossoms opening daily and bulb pigmentation. However, despite these differences they still adhered to the concept of *C. flaccidum* as possessing many forms but having a unity of type. Hannibal (1965) had even traveled to Pichi Richi Pass in Australia in 1964, but apparently later in 1965 he changed his opinion after discussions with Traub and agreed to designate *C. luteolum* as a separate species.<sup>1</sup>

The basic argument from Australian botanists as explained by Hewson (1987) for reducing *C. luteolum* to a synonym of *C. flaccidum* was that colour wasn't a sufficient feature for creating a new species and that research was required of the *C. flaccidum* complex in the field to determine if there were substantial differences in the populations that showed variant characteristics. He considered that the yellow flowered *Crinum* was a distinct forma of *C. flaccidum*, but that this species was so variable that one

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Footnote <sup>1</sup>: Ironically, Hannibal (1970-71) later changed his mind again and decided that the Pichi Richi *Crinum* was a variety of *C. pestilentis*, publishing *Crinum pestilentis* var. *luteolum* comb. nov. without supporting information or discussion.

could find analogues of most taxonomical differences in other variants.

However there is now additional evidence of the many phenotypic differences between the *C. luteolum* variant and *C. flaccidum*, and we are now in a position to support the accuracy of the descriptions and observations made by Traub in his 1966 description. All pictures of *C. luteolum* in flower and of garden cultivated plants indicate that they are homogenous in their floral characteristics and have similarly shaped tepals and primrose yellow hued flowers. My research into the patterns of growth and flowering of *C. luteolum* has lead to a visit to the known sites over a seven year period. I was particularly interested in verifying the level of variance in the flower size, shape and colour, and to obtain a treasury of images of this species in massed flowering.

Due to a ten year drought which ended during January-February 2011, there was only one occasion where we confirmed that widespread flowering had occurred in one population. The flowering during January 2005 (mid summer) was due to a heavy downpour of about 8cm during early December 2004. The *C. luteolum* variant on the salt bush plateau was the only population to flower with heavy seed set in late February. It is clear that the rain storms at the end of summer can be very localized and that in most years only a minority of colonies receive sufficient rainfall to initiate flowering. When dry climatic conditions prevail, this variant adapts by senescence of its leaves and dormancy until there is substantial rainfall. During the past 6 years of drought – on three occasions localised rainfall led to leaf growth. The luteolum variant and the related Murray River variant growing in the South Australian arid and desert zones appear to have short autumn-winter growth periods, while the failure of rainfall leads to years of dormancy. Our knowledge of their cyclic growth, rest and flowering patterns is gradually becoming apparent.

The chief botanist of the South Australia Botanical Gardens, Lothian (1957), held the opinion that it was difficult to give specific status to the yellow Pichi Richi *Crinum* as there were other desert *Crinum* in South Australia that were intermediate between it and the forms of *C. flaccidum* found in locations near the Murray River. However, J. Jessop, the editor of the Flora of South Australia (1978), appears to have considered that Traub's expanded determination of *C. luteolum* had some merit for he provided a summary of the distinctive characteristics identified by Traub.

In contrast, the *C. luteolum* variant is now known to have at least five

## Chart of distinguishing features between *Crinum flaccidum* and *C. luteolum*

<i>C. flaccidum</i> -- type form	<i>C. luteolum</i>
Flowering after late summer rainfall, typically from January to early March	Flowering is advantageous following late spring, summer or early autumn rain from late November to late April
Both near symmetrical and zygomorphic flower forms grow together. Flower shape variable – lanceolate to ovate and oblanceolate segments. Colour varies from dominant white flowers to light pink coloured flowers. The white flowers may have pink, bronze, pale green or rose-wine coloured exteriors to flower segments and in the colour of scape and umbel.	Evenly shaped elliptical segments, significantly firmer textured than type, relatively wider for segment length. All flowers are light green in bud, changing to light primrose yellow coloured flowers, with green coloured scape. Some variation in hue of yellow pigment on flowers.
Radial distribution of flowers around umbel – from 7 to 12 flowers (avg 8). Filaments usually white, sometimes tipped with rose-purple colour. Flowers are generally short lasting on average 2 days, and have thin texture. Perianth tube from 2.5cm to 7.5cm long and usually curved. Long thin filaments tending to bunch near the style – lacking any stable order.	Flowers exhibit phototropic facing toward the midday sun, from 8 to 22 flowers (avg 12). Filaments are yellow coloured. Flowers about 70% of the size of the average type form. Flowers are of heavy texture, have a waxy appearance, and each are relatively long lasting 4 to 5 days. Perianth tube from 1.5cm to 5cm long, most are straight, some slightly curved. Filaments evenly spaced, arranged along two layers and firmer in positioning.
Leaves are winter deciduous. Bulb usually globose to egg shaped.	Leaves are evergreen, only becoming deciduous in response to a dry spell. Pear shaped bulb with tapering bulb neck.
Flowers have sweet spicy fragrance in daylight and are strong nectar producing – with tepal tube filled, attracting many native bees and some indication also of sphingid - multiple pollinators.	Pungent strong odor strongest at dusk – nectar rarely filling tepal tube. Pollinated by unknown species of sphingid moths or flies, definitely unattractive to native bees.
50 to 62cm year round rainfall pattern with drier winters.	15 to 20cm average rainfall. Very dry hot summers with wet winters.
Mainly alluvial sand, black swampy clays, loamy sand pH 5.5 to 6.5.	Mainly marine deposits of mudstone and limestone and shale horizon pH 8 to 9.5 and alluvial sand.



large colonies on an arid low-saltbush plateau at the southern end of the lower Flinders Ranges in South Australia near Port Augusta. It grows in full sun, on soils from sedimentary marine deposits of shale/mudstone, in a poorly defined sandy clay soil embedded with shale. The known populations of *C. luteolum* are separated from other related *Crinum* variants in the desert regions further north by the Southern Flinders Ranges, by the lack of any connecting water drainage lines, and by the total lack of any connection with the Lower Murray River variant, the closest colonies of which are 489km to the west.

#### DESERT *CRINUM LUTEOLUM* VARIANT

There is a desert *Crinum* related to *C. luteolum* that is found in the arid Salt Lake zones of South Australia with average annual rainfall of 10 to 12cm. They grow on slightly elevated banks along the flood plains of dry creeks that flow into the numerous salt lakes in the Torrens/Eyre systems. Flowering of this desert variant is initiated only after a brief period of heavy rain in the desert with falls greater than 20 to 30mm – they are frequently dormant for a number of years until moisture reaches the deeply set bulbs – up to 60cm deep. Lothian (1957) described the large size of the bulbs, weighting up to 2.8kg with diameters of 10 by 15cm. This desert variant has yellow flower buds and its flowers are yellow for at least half a day. Some forms retain a yellow eye while in others the flower turns a creamy or white colour with age.

The main differences between it and *C. luteolum* are the heavier flower displays – up to 9 small blooms in flower at once, from two to three spiral centers in the umbel. The blossoms last for 3 to 4 days before senescence in heat wave temperatures of up to 45°C, whereas *C. luteolum* usually has only 3 flowers opening together, and these are much more heavily textured, each lasting up to 4 to 5 days. The *C. luteolum* flowers are also phototropic in comparison with the radial display of the desert variant form. The odorous or fragrant qualities of this desert *Crinum* should also be noted – both it and *C. luteolum* have the fragrance of really smelly socks, with the desert form being more powerfully pungent. The flowers of these *Crinum* variants exhibit the characteristics of moth pollination, and they have pale-coloured perianth flower segments that open during the night, emitting a strong unpleasant fragrance.

There are physical barriers that have geographically separated *C.*

*luteolum* and the desert forma. There is no connection by waterways between the habitats of these two variants, and it is known that there were very severe arid periods in this region around 10,000 years ago. It's likely that these arid periods led to diminishment of the population ranges for these *Crinum* species, and that refuge areas held a few *Crinum* until the moister periods that eventually followed. The existing colonies of *C. luteolum* however, are situated in locations where there is no prospect of water borne distribution of their seed. So these small refuge islands are the only remaining lifelines.

### CULTURAL CONSIDERATIONS

*Crinum flaccidum* is a winter dormant, summer growing species and shares this attribute only with the *C. brisbanicum* variant. All the remaining variants including *C. luteolum* are winter growers and are potentially evergreen by being advantageous in responding with leaf growth throughout the year following sufficient rainfall. Senescence appears to occur after relatively short dry spells and summer heat. Basically *C. flaccidum* is a late spring to early summer grower while *C. luteolum* responds best if given a totally dry period in summer and then heavily watered in the final month of summer. To obtain reliable flowering, it's important to observe these watering guidelines, otherwise flowering will tend to diminish over successive years.

Another factor is that of soil pH. The three variants (*C. luteolum*, desert yellow, Lower Murray River) from the State of South Australia grow in limestone derived soils and alluvial deposits with pH levels from 8 to 9.5. So these three variants will grow and flower closer to their optimum if their potting mix is provided with some dolomite in each growing season.

The white flowered variant that grows around the Lower Murray River is exceptionally robust and is known to be a hexaploid variant. Its leaves are longer and wider, channeled more upright than any of the other variants. Large flowers are also typical with considerable variation in flower shape such as long narrower tepals.

### SUMMARY

There are a range of significant taxonomical differences between the type form of *C. flaccidum* and the Southern Flinders Ranges yellow *Crinum*. These differences appear sufficient on their own to affirm the species status



**Fig. 14.** Desert variant of *Crinum luteolum* with a strong yellow colour, Andamooka, South Australia, February 16, 2007.



**Fig. 15.** Desert variant of *Crinum luteolum* whose flowers have a yellow eye, Farina Station, South Australia, February 19, 2010.



**Fig. 16.** Desert variant of *Crinum luteolum* whose flowers have a creamy colour, Andamooka, South Australia, February 19, 2010.



**Fig. 17.** Desert variant of *Crinum luteolum* in seed, Strzelecki Tract, South Australia, February 20, 2010.

of *C. luteolum*. The different nature of the pollination vectors in these two *Crinum* as evidenced by the nature of their different fragrances is also important in understanding the level of separation between them.

In my garden the flowers of the type form of *C. flaccidum* strongly attract small black native bees of genera *Trigona*, which are 4mm long. The bees tend to congregate around the opening flower buds and strip the pollen from the anthers within an hour. However, no native bees will visit the flowers of the nearby *C. luteolum* bulbs in flower. The Lower Murray River variant however, appears to have two different pollination vectors – for it has a weak sweet scent in the morning warmth of the day and an odourous scent as dusk falls. However the local native bees don't visit it either.

*Crinum luteolum* has been physically separated from all other variants of *C. flaccidum* and the type form for a considerable time. Over this period it has adapted to its changing environment and perhaps its colour adaptations are a sign of the influence of its pollinator in favouring light yellow flowers. Research into the reproductive ecology of *C. luteolum* would, I am sure, verify the nature of the relationship between this *Crinum* and its pollinators. In closing I would like to leave you with a short account of the first recorded *Crinum flaccidum* enthusiast, Mr. Phillips, taken from an 1845 journal entry by the explorer and naturalist, Ludwig Leichhardt:

“25/1/1845 Mr. Phillips is rather singular in his habits; he erects his tent generally at a distance from the rest, under a shady tree, or in a green bower of shrubs, where he makes himself as comfortable as the place will allow, by spreading branches and grass under his couch, and covering his tent with them, to keep it shady and cool, and even planting lilies in blossom (*Crinum*) before his tent, to enjoy their sight during the short time of our stay.....As the night advances, the Blackfellows' songs die away; and the chatting tongue of Murphy ceases.....”

### All photographs by the author

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## CAPE YORK - A TROPICAL AUSTRALIAN *CRINUM* HUNT

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Exploration of Australia for *Crinum* species has become somewhat of an obsession for me, flamed by the equally obsessed Jim Lykos and Dave Lehmler. Either in pairs or with three of us together, we have had six field trips to South Australia, New South Wales and Southern Queensland, and the Northern Territory (Hamilton 2007, 2008, 2010; Lehmler 2008; Lehmler & Lykos 2010). During the early spring of 2010 (Southern Hemisphere), it was arranged that we would meet on 2<sup>nd</sup> December in Cairns to travel and observe crinum of Far North Queensland. Our visit would be during the pre-monsoon storm season, when there would hopefully have been enough rainfall to bring crinum into growth but not enough rain to make roads impassable, as is the case during the monsoon season.

It was 32°C (90°F) when I arrived at 7pm, having taken most of the day to travel the 3000km north from Hobart in South Tasmania because of delayed flights. Acclimatised to summer days of around 20°C (68°F), my expectations of discomfort from the tropical North Queensland heat were soon realised. I picked up our 4WD vehicle and checked into our first nights accommodation. I returned to the Cairns airport at 9:30pm to meet Jim's flight from Sydney, and we both returned after midnight to meet Dave who had travelled from the United States via Guam.

After very little sleep, our first port of call was to visit Dr. Fanie Venter at Clifton Beach about 20 minutes drive north of Cairns. On the way we passed amazing displays of *Hymenocallis* including one with variegated leaves, decorating the medium strip of the James Cook Highway. Fanie was a botanical and environmental consultant and an associate of the Australian Tropical Herbarium situated at the Cairns campus of James Cook University. He had completed a field trip of Cape York studying *Nepanthes* species only 3 weeks previously with a PhD student he was supervising. While this was before most of the rainfall had started, he still had some valuable crinum sites recorded which he passed on to us. We took a short ride from his home to the southern end of Clifton Beach where

he showed us *Crinum pedunculatum* R. Brown in bloom. They were behind the beach close to a small lagoon, surrounded by mangroves. It was here we saw the first sign warning of the possibility of salt water crocodiles in the vicinity, a sign we saw on many more occasions during our trip. Happily we didn't encounter any crocs.

The iced tea Fanie gave us before leaving was very much appreciated as we were all feeling quite uncomfortably hot by this time. From his home after a short distance travelling south, we headed in an easterly and upward direction through rainforest past Kuranda, and after about 60km we arrived at Mareeba where we joined the Peninsula Developmental Road which would take us in a generally northerly direction into Cape York. Soon after passing Mareeba we encountered our first *Crinum angustifolium* R. Brown, just a single flowering plant and only a few non-flowering plants growing in heavy, clayey soil, in light bushland. We encountered a couple more sites with one or two flowering *Crinum* before we came across a population with quite a few flowering plants, near Bullhead Creek just south of Lakeland. About 60km north of Lakeland we arrived at the town of Laura or more accurately the Laura River which was flowing strongly after a storm the previous evening that gave the area 97mm (almost 4 inches) of rainfall. We were relieved to watch another vehicle cross the 50-60m of flooding river before we had to cross it, thereby knowing it wasn't too deep for our vehicle. Thereafter 95% or more of the road we were travelling was unsealed with just occasional patches of sealed road at creek crossings, or for a few kilometres to allow safer overtaking of vehicles. Additionally the cattle stations were no longer fenced, so we had to be constantly on the watch for the Brahman cattle which are grazed in the tropics.

Our next landmark on the northerly route was the Hann River Roadhouse. About 5km before arriving we encountered *Crinum uniflorum* F. Muell. growing adjacent to 4 small creeks over a couple of kilometres, in boggy soil sometimes under water, in quite open conditions. One can imagine that this small *Crinum* would be under water for several months once the monsoon started bringing almost daily storms. There appeared to be two distinct species being called *Crinum uniflorum* with this being the smaller of the two, complicated by the fact that the original herbarium specimen for this species lacked any leaves. It had a single flower, very occasionally two flowers which were white or very occasionally pink. Leaves were usually about 2mm wide with bulbs about 2cm in diameter.





**Fig. 1.** *Crinum pedunculatum* at Clifton Beach north of Cairns.



**Fig. 2.** A robust *Crinum angustifolium* near Bullhead Creek.



**Fig. 3.** Small form of *Crinum uniflorum* south of Hann River.



**Fig. 4.** Small form of *Crinum uniflorum* in bud, also showing its fine leaf, south of Hann River.

At the 4<sup>th</sup> population there were plants of *Crinum angustifolium* growing in the periphery as well as obvious hybrids between the two species. The hybrids had wider leaves than this *Crinum uniflorum*, but much smaller than *Crinum angustifolium*, with between two to four or five flowers. Dave and Jim had encountered similar hybrids when they travelled in Northern Territory in December 2008 (Lehmiller, 2008).

We passed the Hann River Roadhouse aiming to travel a further 60km or so to spend the night at Musgrave Roadhouse. Our progress was halted on several occasions by roadworks, and about 15km south of Musgrave we were flagged down by an approaching vehicle. He told us that the Morehead River was flooded, and while the bridge over the river was passable, there was a dip after the bridge which was showing a depth of 0.8m (about 32 inches) which would be impassable for our 4WD which lacked a “snorkel”. Already one vehicle had been caught in the water. We travelled a little further before deciding to return south to look for overnight accommodation. On our return about 13km north of Hann River, we spotted a population of *Crinum* which we had missed on the northerly trip and this turned out to be, what I will call for the time being, the larger form of *Crinum uniflorum*. The habitat was quite different with the bulbs growing in deep coarse sand in the shade of small paperbark trees. Two flowers were common and an occasional plant had 3 or 4 flowers, with occasional pink flowers among the mainly white population. Leaves were up to 5-6mm wide and bulbs 4cm in diameter.

We were relieved to find that we could stay at Hann River Roadhouse, albeit in fairly primitive conditions with toilet and bathroom about 100m removed from our hut, which at least had an old, but effective air conditioner, this being an essential item for sleep. The roadhouse provided accommodations for the road workers we had encountered, and it provided us with a passable evening meal before a fairly early retirement. There wasn't actually much sleep had by any of us that night, with concerns about flooded rivers and creeks, and with disturbances by a noisy peacock who had roosted in a tree quite close us, as well as other unidentified noises, all contributing to insomnia.

Dawn came at about 5:30am. It wasn't so much the time we woke, more the time we finally gave up hope of any useful sleep. With no opportunity for food this early, we packed our gear and headed north again well before 7am, a habit which stuck with us for the rest of our trip. We stopped at the

larger *Crinum uniflorum* site we had seen last in the previous afternoon to take some early morning photographs. Continuing north we crossed the Morehead River and the now dry dip after the bridge, which had subsided overnight. About 17km south of Musgrave Roadhouse we once again found a population of the larger *Crinum uniflorum*, this time growing in association with a grass tree, probably *Xanthorrhoea johnsonii* which has a wide distribution from Cape York to as far south as northern New South Wales. After more photographs we continued on and passed a further population of the same *Crinum* before arriving at the Musgrave Roadhouse, where we had the breakfast we greatly needed. We were sorry we hadn't reached here the night before, as it appeared it would be a nice place to stay.

Feeling refreshed we continued north with the next leg about 100km to the small town of Coen. After travelling for 10 or 15km we started to see populations of the larger *Crinum uniflorum* very regularly and this continued on for 30 or 40km. About 35km south of Coen we stopped to investigate a large population and found that many of the *Crinum* had maturing seed capsules as well as plenty of flowers. This population spread for several acres and the *Crinum* were so dense that it was difficult to move around in some places without crushing plants. Approaching Coen we encountered some large birds, which I later identified as bustards. They were over a metre tall and while they were once common, they now live only in unpopulated areas, such as Cape York, where they feed on open grassland. Coen was an uninviting town with the local hotel unwilling to provide us food before its advertised midday starting time. The small general store provided a few snacks, and as we headed through the town we stopped again to inspect a small population of *Crinum angustifolium*.

We decided to aim for lunch at Archer River Roadhouse some 65km further north. About 20km north of Coen we passed another population of the larger *Crinum uniflorum*, again growing in association with *Xanthorrhoea johnstonii*. Arriving at Archer River we were bemused to see a sign stating they were closed for renovations! Fuel was available, but once again no food, so we continued on, more hungry as the time passed. The Archer River was quite wide with its bridge now no more than 90cm above the water level. It was easy to imagine that this crossing would be closed after any significant rainfall in its catchment. Another 30km or so north we stopped to examine a population of the smaller *Crinum uniflorum* growing once again in heavy moist soil, with plants of *Crinum angustifolium* also

present, but no sign of hybrids between the two species on this occasion. It was obviously a second wave of flowering for the small *Crinum uniflorum* as mature seeds were present among flowering plants. We soon discovered this population was only 3km south of where the road divided with the Peninsula Development Road heading in a north westerly direction towards the bauxite mining town of Weipa, and the Bamaga Road heading mainly north towards the tip of Cape York.

Our aim was to reach Weipa for our next night stop, the town where Fanie had seen a single blooming plant of *Crinum venosum* R. Brown 3 weeks earlier. This was a further 150km, and while we had been driving on unsealed roads most of the day which were in fairly good condition, the Weipa road was made of softer material so the heavy rainfall and traffic of the preceding days had made much of the first 100km or so rough, muddy and simply unpleasant for driving. We did however have regular sightings of *Crinum angustifolium* for the first 30km or so, including an interesting population which was of smaller size than most of the others we had seen. At most sites it was just a few flowering plants among fairly large populations. At one stop, we encountered a very attractive member of the ginger family, *Curcuma australasica*, otherwise called the Cape York lily or native turmeric. It had very attractive pink and yellow flowers emerging between the typical leaves of the ginger family. Another interesting find was the terrestrial saprophytic orchid *Dipodium stenochilum* on the roadside at one of our stops.

It seemed to take a very long time but we eventually arrived at Weipa and drove directly to the caravan park, as it was the beach adjacent to the park where Fanie found *Crinum venosum*. After a short search a *Crinum* in fruit was found, this probably being the one seen flowering 3 weeks earlier. Further search found scattered plants along the edge of the beach and a few plants among long grass at the end of the beach. We eventually decided on spending the night at the caravan park after having looked at the other possibilities in the town and were delighted to secure a modern cabin, on stilts, which overlooked the beach. It was luxury compared to our previous night, and we all enjoyed a cold shower before an evening meal at a local hotel. We had travelled almost 1000km in our first two days and were now 800km north of Cairns.

The next morning I was delighted to look out from the deck of our cabin and see several Jabiru or black-necked cranes feeding in the shallows.



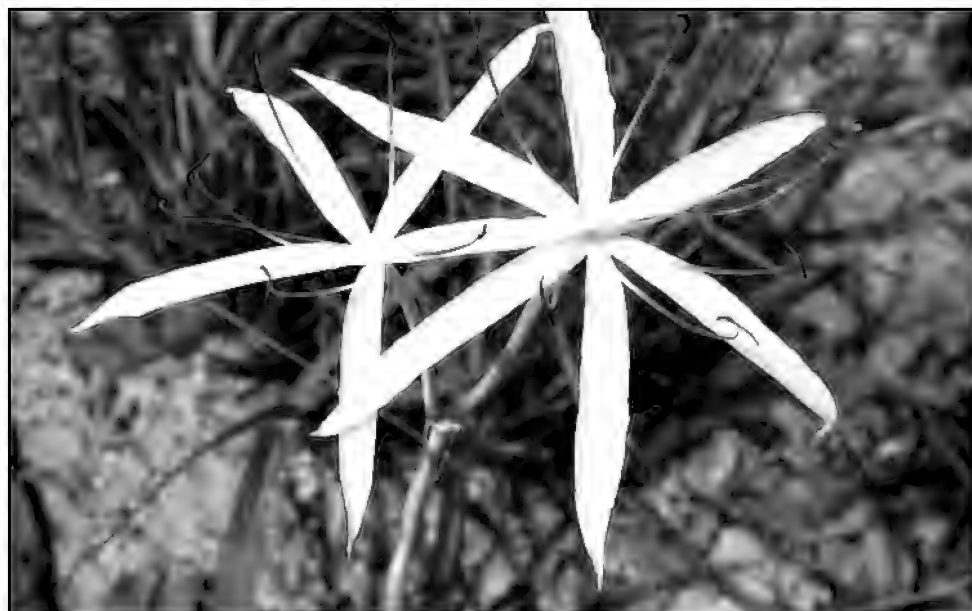
**Fig. 5.** Large form of *Crinum uniflorum* - a nice pink - north of Hann River Roadhouse.



**Fig. 4.** Large form of *Crinum uniflorum* south of Coen, including an ant mound.



**Fig. 7.** Large form of *Crinum uniflorum* south of Coen.



**Fig. 8.** Large form of *Crinum uniflorum* in bloom south of Coen.





**Fig. 9.** Large form of *Crinum uniflorum* with a grass tree *Xanthorrhoea* species north of Coen.



This graceful black and white bird stood 1.2m (4 feet) tall. While I was attempting to photograph the Jabiru, Dave and Jim, still on the deck, saw dolphins feeding close to the shore. I was disappointed that they didn't surface again after I began a dedicated watch for them. There was a nice assortment of other shore birds including pied oystercatchers (also seen 3000km further south on Tasmanian beaches), marsh sandpipers, bar tailed godwits, red-necked stints and greenshanks. On my return to the cabin from the beach I took a slightly different route and found a *Crinum venosum* in bloom on the edge of the beach. Jim and Dave searched further in the long grass at the end of the beach and eventually found a large population of this *Crinum*.

Compared to the previous morning we had a leisurely departure from Weipa to retrace our route of the previous day. The muddy road didn't seem so arduous while fresh in the morning, and we were soon to the junction with Bamaga Road ready to head south. From this junction we were within 200km of the tip of Cape York, but we had decided not to attempt this leg because of the risk of heavy rainfall stranding us for perhaps days and the very good reason that the car rental company specifically advised that insurance would be void if we crossed the Jardine River on the vehicular ferry, an essential part of the final leg. We stopped at the small *Crinum uniflorum* population, just south of this junction to collect seeds and further examine the population. It was growing amongst termite mounds whose shape caused us to nickname them graveyard termites. The size and shape of the ant and termite mounds we saw were many and varied and almost constantly present in the far north. During the drive south we encountered another large bird pair, the Brolga or dancing cranes who demonstrated their steps for a short time. We possibly also saw a similar large bird the Saris crane. Both have grey bodies and varying degrees of red on their heads.

We stopped at Musgrave Roadhouse which was quite busy at lunchtime on Sunday and enjoyed our food, having had very little to eat since leaving Weipa without breakfast. We enjoyed the friendly atmosphere and the sense of humour of the proprietor, who advised us to head as far south as Lakeland, rather than risk a night at Laura, where we could possibly be stranded by the Laura River, if overnight storms occurred. South of Coen we stopped and collected seeds and representative bulbs of the larger *Crinum uniflorum*, as well as the smaller *Crinum uniflorum* and hybrids



**Fig. 10.** A member of the ginger family, *Curcuma australasica*, roadside on the way to Weipa.



**Fig. 11.** *Crinum venosum* on the beach at Weipa.

south of the Hann River. The Laura River had now subsided to just a trickle across the road as we crossed it travelling south. It was approaching dusk as we arrived at Lakeland having covered 580km for the day, with 500km of that having been on unsealed roads. We were dissatisfied to find the local motel was full and were lucky to secure the last 3 beds in the caravan park.

We had a nice breakfast at the Lakeland Roadhouse, and then headed back south to Laura where we entered the Lakefield National Park, planning to take an alternative route through the southern part of the park to Cooktown, our planned stop for the next night. On our way to Laura we passed another flock of bustard grazing in roadside paddocks. The Laura River had subsided completely so the crossing was simple. Somehow we missed the turnoff to Cooktown, perhaps because there was roadwork occurring close to the turnoff, and therefore continued in a northerly direction through the park rather than heading east to Cooktown. As we travelled we commented to each other on how the habitat looked very good for crinum. We actually stopped at one of these sites to investigate further, and found it had the heavy moist soil enjoyed by some of the other crinum we had encountered. We searched in vain and decided to continue our travels. Restrooms are few and far between in such outback localities and during a call of nature before leaving, one of us noticed the leaves of a crinum plant. The leaves were smaller than *Crinum angustifolium* and larger than the *Crinum uniflorum* forms. We intensified our search, and moving further from the road we eventually found two plants in flower. The most impressive of these had 5 of its 8 flowers fully open in a horizontal plane and was clearly different to any of the crinum we had seen on this trip or previous trips around Australia. Our immediate thoughts were that we had found a new species.

We continued on and within a couple of kilometres we came upon a population of *Crinum angustifolium*. Its differences to the previous species reinforced our feelings that we had found an undescribed species. Continuing on we were enticed to take a short side track to what was signposted as Catfish Waterhole. It was a narrow dirt track and we had to cross water several times. Arriving at the waterhole site the usual crocodile warnings were posted and some large lily pads were seen on the waterhole. We soon found crinum leaves but no flowers on this occasion. They looked similar to those of the probable undescribed species and were again growing

in heavy moist soil. I noticed some other interesting leaves emerging in parts of the clearing near the waterhole, photographed them and later discovered that they were the leaves of *Tacca leontopateloides*. Departing from the waterhole we stopped to examine a couple of quite large specimens of *Crinum angustifolium* flowering beside the track. Continuing further northward (as we later found) we passed several areas of wetlands where we saw Jabiru, Brolga, a possible Saris crane and one large white egret.

After 20km or so we passed more flowering crinum and stopped to investigate. It proved to be the same undescribed *Crinum* species. This time there were quite a few flowering plants scattered among a large number of plants over several acres. Again the soil was heavy with a few areas of standing water. Continuing on we began to feel uneasy about the direction we were travelling. We arrived at signs pointing to the Lakefield camping area and consulting with maps we discovered we were 50km past the turnoff to Cooktown. We retraced our path but not with too much regret because of our discovery. This time we found the turnoff to Cooktown at Old Laura, but after travelling about a short distance we came across the Laura River. Here there was no bridge and it was 60-70m wide and flowing fast. We decide not to cross it and headed back to Laura, then Lakeland to take the main road to Cooktown. We were keen to explore the section of road we had been unable to reach, as Fanie had heard of a possible miniature species like *Crinum venosum*, seen in this area. We decided to attempt to approach this area from the Cooktown end the next day. We stopped briefly to look at some nice specimens of *Cycas media* on the way to Cooktown and closer still we saw some large specimens of *Crinum angustifolium*. Within the town we stopped to look at a garden with some marvellous specimens of *Proiphys amboinensis* and *Scadoxus multiflorus*. We settled in a cabin park, and I had a very refreshing swim in the park's pool before dinner at the local lawn bowls club. The garden around the pool was planted with *Crinum xanthophyllum*.

The next morning we visited the Cooktown Botanical Garden at 7am. It was already quite hot and humid, the latter increased by watering in the gardens. There were many very old trees making the gardens very shaded, with cycads and palms in the understory. We emerged at the eastern end of the gardens at Finch Bay where we hoped to find some seaside *Crinum pedunculatum*, but we were unsuccessful in this quest. We returned to our car on the road leading to Finch Bay, which was slightly more comfortable being



**Fig. 12.** *Crinum* species nova in Lakefield National Park.



**Fig. 13.** *Crinum* species nova in Lakefield National Park.



**Fig. 14.** Jabiru or black-necked crane in the shallows on the beach at Weipa.



**Fig. 15.** Saris crane in wetland in Lakefield National Park.

less humid. We found another *Dipodium* species in flower at the roadside.

We then headed north on the road to Hopevale, towards the eastern approach to Lakefield National Park. We were aware of a probable water crossing at the site of Isabella Falls but our motel host assured us it was passable. About 40km from Cooktown we reached the Isabella Falls crossing which was perhaps only 40m wide but looked to be fairly deep. I put on my knee high gumboots to wade through the water and immediately had gumboots full of water, with a soft muddy bottom. After about 10m it became shallower, with a solid rock base but it was clearly not possible to cross it in our vehicle with a conventional exhaust. Disappointed we turned back, but decided to explore the Cooktown McIvor road a little further north which provided a possible bypass of the deep crossing. We travelled about 10km along this road and saw many *Cycas media*, plus palms and grass trees. We also found another *Dipodium stenochilum* slightly lighter in markings than that we saw on the Weipa road. We had to cross water several times on the road with these proving to be more soft and boggy as we proceeded, so we finally turned back when we faced water which looked wider and deeper than before. Closer to Cooktown on the road we turned into Cameron Creek road and after 200m a very robust *Crinum angustifolium* with 15cm flowers, once again growing in heavy moist clay. We found a similar robust population down a road which led to a dry lagoon a few kilometres from Cooktown as we headed back towards Lakeland.

About 15km out of Cooktown we noticed another white inflorescence some distance from the road which looked a little more dense than the *Crinum angustifolium* we had been seen. On investigation we found it was *Proiphys amboinensis*. This flowering plant was on the edge of open pasture and quite dense woodland. The other plants we found were all in quite shaded situations in the patch of dense woodland which followed a dry creek bed. They were covered with a generous layer of leaf litter in fairly soft loamy soil and the bulbs were quite shallow. We were lucky that one plant had established in a semi open position making it easy to find. *Cycas media* was growing nearby on the small hills on the other side of the creek. Continuing on we passed a group of 30-40 magpie geese in a roadside paddock and lunched again at the Lakeland Roadhouse which we had come to enjoy because of its food, the nice selection of books it had on Cape York, and its gifts making choices for family at home quite



**Fig. 16.** *Proiphys amboinensis* near Cooktown. Photo by Dave Lehmillier.



**Fig. 17.** *Proiphys amboinensis* near Cooktown.



easy. After lunch we travelled south towards Mareeba seeing occasional *Crinum angustifolium* and another huge flock of magpie geese numbering hundreds, perhaps a thousand, in a mango orchard. From Mareeba we took an inland road south to Atherton and from there took a road east down through the rainforest to the coast, to spend the night at Innisfail about 80km south of Cairns. During this afternoon we travelled in the first significant rainfall we had encountered, as we skirted around the edge of a huge storm, thankfully missing its full force. We found a very nice motel in Innisfail and dined very well in its restaurant that evening.

Before heading south the next morning we travelled towards the coast from Innisfail where we saw a nice clump of *Crinum zeylanicum* flowering in a garden, then later a lovely pink hybrid *Crinum* in another garden. Our first stop was to be at Mission Beach where Jim had seen some nice plantings of *Crinum douglasii* (now considered *Crinum pedunculatum*) in a past visit. On the way towards the coast again to Mission Beach we stopped to do a short rainforest walk where we saw some small specimens of another Australian cycad, *Bowenia spectabilis*. Here we began to see signs warning motorists to be careful of cassowary crossing the roads. Cassowaries are large flightless birds, which live in the rainforests of northeast Queensland. While we didn't find the *Crinum douglasii* planting, we did see *Crinum pedunculatum* both in gardens and beachside at Mission Beach before enjoying a mid morning breakfast which had become our habit. (Sadly Mission Beach took the full force of Cyclone Yazi a few months after our visit with devastating destruction.) Leaving Mission Beach we travelled through the town of Tully, the site of large sugar mills and much of the countryside was planted with sugar cane. From here we headed back to the coast to explore Tully Heads and Hull Heads, which had herbarium sites on record for *Proiphys amboinensis*. We found only some beachside *Crinum pedunculatum* in bloom along the beach, and I was able to photograph a group of stone curlews sheltering under small shrubs, from one of the several heavy showers we encountered during the morning.

Our next stop was south of Cardwell where extensive searching of both sides of Sunday Creek failed to find a *Crinum* species which appeared unusual when we had examined its herbarium sheet. There were plenty of grass trees and a cycad which may have been *Cycas media* var. *banksii*. There was also an interesting white terrestrial orchid, which I later identified as *Didymoplexis pallens*, and the emerging leaves of another

terrestrial orchid perhaps a *Calanthe* species. Fifty km north of Townsville we encountered *Crinum angustifolium* again, in bloom and with some mature seed. We found plenty of this species in the Bluewater and Yabalu regions a little further south where we explored a number of side roads, but we were unable to locate any of the *Proiphys* species which herbarium records suggested were in this region. There were large numbers of *Crinum angustifolium* in most sites but only a few were flowering.

The next morning we made a very early visit to the Townsville Botanical Gardens where there were some amazing, exotic cycad specimens, several large *Pachypodium* as well as an interesting collection of *Tacca* species or bat plants. Following this we drove to the top of Castle Hill, a rocky outcrop, which was near the gardens. From here there was an amazing view of the whole city and across to Magnetic Island, a popular resort destination. We then headed inland, in a westerly direction towards Charters Towers. For there we would head in a generally northerly direction along the Kennedy Highway, otherwise know as the Great Inland Road. Over the first 30km or so we passed scattered populations of *Crinum angustifolium* as well as a few interesting birds in wetland areas, white ibis, magpie geese, cormorants and a pair of grass whistling ducks. We had to slow our vehicle at one stage to allow a pair of emus to cross the highway. The rest of the trip to Charters Towers was uneventful until within the town boundary when we came upon a garden with a huge clump of a magnificent pink *Crinum* hybrid in bloom. We chatted with the owner who had no knowledge of its ancestry, but Dave suspected it was a *Crinum flaccidum* x *C. moorei* hybrid. After breakfast in Charters Towers, we headed north on what was a long and at times tedious afternoon's driving where we covered almost 600 kilometres.

We found *Crinum angustifolium* again about 30km north and then again at a place called Fletchers Creek Campsite and again a short distance past the campsite. At one stage we passed camels grazing in paddocks alongside the typical Brahman cattle we had been seeing all trip. There were one or two more *Crinum angustifolium* populations including at our next stop at Bluewater Springs, where we had lunch. This was a place where there appeared to be herbarium sites for *Proiphys* species although we hadn't seen any dense forest habitat in which it was likely to grow. We were fascinated by a group of apostle birds, which had taken temporary residence beside a petrol bowser at the roadhouse. We questioned the



**Fig. 18.** *Tacca* species flowering at Cairns Botanical Garden.



**Fig. 19.** Jim Lykos (left) and Robert Hamilton (right) standing in front of a magnetic termite mound near Lakefield National Park. Photo by Dave Lehmiller.

roadhouse staff about possible *Priophys* habitat and were directed to a side road further north, which lead to a river crossing. Investigating this road was unproductive except for more *Crinum angustifolium*, some with flowers 20cm (8 inches) in diameter. Continuing on it was perhaps the most tedious part of our whole trip. At times the road was one lane narrow and we had to be careful to get off the road if we met road trains, which we did quite frequently. We still continued past scattered *Crinum angustifolium* populations including just before and soon after The Lynd junction and just after the town sign for Mt. Garnet. We had considered this town for a night stop but the accommodation possibilities were not impressive. The next town was Innot Hot Springs and there were *Crinum angustifolium* growing within the town boundary. We were tired and weary when we arrived at Ravenshoe at dusk and were pleased to find a small motel with spare rooms. We had dinner at one of the local hotels, which boasted to be the hotel at the highest elevation in the Atherton Tablelands. It was at 914m above sea level. It raised the possibility that the crinum populations from this area might be more winter hardy, as these areas were cold enough to be subject to occasional frost in winter.

The next morning we visited a waterfall near Ravenshoe and travelled a distance down Tully Falls Road where we saw only a few interesting grass trees. We then returned to Cairns via Atherton and Mareeba and met Fanie again at his home, before visiting the Australian Tropical Herbarium at James Cook University where we were given a guided tour and were able to inspect the *Crinum* species held by the herbarium.

With an afternoon to spare we decided to look for a *Crinum* species which was said to be unlike any of the published Australian species. This involved returning to Mareeba, then travelling in a southeasterly direction for 20km or so to Mount Aunt where this *Crinum* was supposed to have been observed. Of course there was also a nearby Mount Uncle to keep it company. We were able to approach Mount Aunt on one side but it was not promising crinum habitat, but it did harbour *Cycas media* including some nice fruiting specimens. Using Fanie's telephone GPS we were able to see the other side of the mountain was more promising having a creek running near its base. Unfortunately getting to this side of the mountain was not possible because a correction facility had been built between the access road and the mountain. We left dissatisfied and did a little more exploring in Granite Creek Road, where more of the cycad was found.

A friend of Fanie's who lived nearby, reported seeing a nice patch of flowering crinum in the previous week. A visit to this site found they had been ploughed, by the landowner, who was preparing to plant sugar cane.

It was a disappointing end to our afternoon. We headed back to Cairns, dropping Fanie at his home before settling into a motel. That evening we headed to downtown Cairns for dinner. We were amazed to see huge numbers of fruit bats settling into the large trees in the streets close to the Cairns esplanade, the site of a huge range of restaurants. We enjoyed a splendid last meal together at "Bushfire Flame Grill", which featured the Brazilian inspired Currasco.

The next morning we were on the move early as usual and after washing the accumulated mud from our rental vehicle, we visited the Cairns Botanical Gardens. We then drove back to Clifton Beach to take Dave to Fanie's home, where he would spend the next couple of days before returning home. We were all left with a feeling that we had unfinished business in the far north, and wished we had spent some time travelling north of the Weipa junction towards Moreton Telegraph Station and Bramwell Junction, and more time in Lakefield National Park where the possibility of further new species undoubtedly existed.

Hopefully we will meet again sometime soon in the tropics to continue our field exploration of Australia's native *Crinum* species.

### **All photographs by the author unless indicated\***

\*Anyone interested in viewing additional photographs of this expedition is referred to: [http://www.bulbsbirdsnnmore.com.au/North\\_Queensland/Welcome.html](http://www.bulbsbirdsnnmore.com.au/North_Queensland/Welcome.html)

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# MORPHOLOGICAL, ANATOMICAL AND PALYNOLOGICAL CHARACTERIZATION OF *HIPPEASTRUM* CULTIVARS

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## INTRODUCTION

*Hippeastrum* is a bulbous ornamental plant belonging to family Amaryllidaceae. It is native to tropical and subtropical regions of the Americas from Argentina, north to Mexico and the Caribbean (Traub & Moldenke, 1949). In this genus around 60 species and more than 600 hybrids have already been reported. These plants are popularly but erroneously known as 'Amaryllis'; the latter is now a different African genus in the same family. *Hippeastrum* cultivars have unique flowering features; i.e., the double flowers from Japan are particularly beautiful, and Dutch bulbs usually produce flowers first and then vegetative growth starts after blooming. The majority of cultivars have single flowers with six tepals which are arranged on the flower in two whorls of three tepals each. On the basis of flower morphology and type, *Hippeastrum* is classified into five categories, viz. Single, Double, Miniature, Cybister and Trumpet. Plants need plenty of water and fertilization during the growing period, and this will encourage the development of large flowers. Most *Hippeastrum* cultivars come from Dutch and South African sources. Bulbs are now being developed in Australia, Brazil, Israel, Japan, United States and India and grown in the gardens. An extensive cytogenetical investigation on this plant has been carried out. On the basis of cytogenetical surveys, ten major ancestral species have been reported to be involved in the origin of garden cultivars through hybridization and selection.

Literature survey indicated that morphological characterization has been performed in many ornamental crops, viz. Rose (Datta and Singh 2004), *Catharanthus* (Dwivedi et.al, 2008), *Chrysanthemum* (Verma et.al., 2009), *Hibiscus* (Singh et.al., 2009) and *Narcissus* (Banerji et.al., 2010). Morphological and anatomical characterization work on only one cultivar of *Hippeastrum* was reported recently in 'McKean's hybrid' (Saxena

et.al., 2009). In the present investigation, morphological, anatomical and palynological studies were carried out in six cultivars, viz. 'Dutch Belle', 'Snow White', 'Pink Pearl', 'Fire Fly', 'Bleeding Heart' and 'Prakash' to understand the variations in a more precise way. This information will be very useful for breeders in selecting cultivars for hybridization programs.

## MATERIALS AND METHODS

The original colour of the flowers of different cultivars of *Hippeastrum* were compared with The Royal Horticultural Society Colour Chart in daylight, and the number depicting the intensity of each colour was recorded in Table-1 (Anonymous 2001). Stomatal studies were made from leaf epidermal peelings after staining in 2% silver nitrate solution (Datta and Gupta, 1981). Pollen grains were collected soon after anthesis. These were dusted on glass slides and mounted immediately in a malachite green glycerin jelly (Datta, 1986). The pollen grains which were regular in shape, full and had uniform stain were considered as fertile, while those which were irregular in shape, empty and hyaline were regarded as sterile.

## DUTCH BELLE

Morphological Studies: Plants attain an average height of 50cm at maturity. Plants on average produce two sprouts. Each of the sprouts develops into an aerial shoot which produces more than five leaves. Colour of the leaves is green. The average length of the foliage is 50cm and its width is >5cm. During the flowering season each spike directly emerges out from the bulbs. Each bulb produces two spikes. Once it is developed, the growth of the spike is rapid and within a fortnight period it attains the height of 50cm. Average diameter of the spike is 2.62cm and its colour is green. Each spike produces at least four flowers but in some cases only 2-3 flowers occur. The angle of floral arrangement at the top of the spike ranges from 90° to 180° depending upon the number of flowers present on the spike. In general the 90° angle is present when four flowers are present on the spike, followed by three flowers which form at 120° angles, and finally a 180° angle when only two flowers are present at the top of spike. Flower height is more than 16cm and its size is approximately 18cm. Flowers have six petals, which are arranged in two whorls. Petal length is 13cm and petal width is >3cm. Sex organs are well developed. Six well developed stamens are clearly visible. Each filament is long while anther lobes are short.

Length of the filaments is >11cm. Colour of the anther lobe is Yellow-White Group 158A Fan-4, while filament colour is Red Group 52C Fan-1. Colour of pollen grains is yellow. The style is prominent and its length is >12cm. Style colour is similar to the colour of the petal. Colour of the lower half portion of the style is Red Group 43C Fan-1 and the top portion of the style is white and almost similar to the colour of the small trifold stigma. Colour of the stigma is White Group 155A Fan-4. Flower colour is represented by the petal colour, which has three clear zones. The colour of the petal in the outer region is Red Group 52C Fan-1. The colour of the middle zone of the petal is Red Group 48C Fan-1. The colour of the throat region of the flower is Yellow-Green Group 145B Fan-3 (Table 1, Fig. 1).

Anatomical Studies: The number of stomata was 30 per mm<sup>2</sup> of area in the upper epidermis of the leaf, while the number increased in the lower epidermis where >41 stomata per mm<sup>2</sup> were recorded during the observation. Guard cell size (length & width) and pore size (length & width) were almost similar in the lower and upper surfaces of the epidermis. However a difference in epidermal cell size was recorded in the cells of upper and lower epidermis. It was observed that cells of the upper epidermis were bigger in comparison to the cells of the lower epidermis (Table 2).

Palynological Studies: Average length of the pollen grain was 96µm and its width was 67µm. More than 168 pollen grains were counted per mm<sup>2</sup>. A pollen stainability study indicated that 82% of pollen grains were fertile (Table 2)

## SNOW WHITE

Morphological Studies: The majority of 'Snow White' plants attain a height of 57cm and form one sprout with a few cases of two sprouts occurring. The plants produce four leaves. Leaves grow up to 35cm in length while the width is approximately 3cm. Length of the spike is 57cm and its diameter is >2cm; its colour is green and its nature is fistular. At the top of the spike appear buds which open into flowers. Every spike generally produces 3 flowers. Height of the flower is 15cm and diameter across is 11cm. Each flower has six petals. Length of the petal is 10cm and its width is >4cm. Colour of the petal is Yellow Group 2D Fan-1 in the outer region, while its middle portion is White Group 155B Fan-4. The colour of the throat region is Yellow-Green Group 150B Fan-3. Stamens are prominent and well developed. The colour of the anther lobe in 'Snow White' is light yellow, while the basal region of



the filament is Yellow-Green Group 150B Fan-3 and the upper region of it is white. Length of the filament is >9cm. Filaments are slightly bent inwards in the upper region. The anther lobes are well defined. The colour of the anther lobe is Yellow-White Group 158B Fan-4. The style is filamentous and well defined, and its colour is Yellow-Green Group 150B Fan-3 at the base, while its upper portion is white. Length of the style is approximately 10cm, and at the tip of style lies the small stigma which is white (White Group 155B Fan-4) in colour (Table 1, Fig. 1).

*Anatomical Studies:* Number of stomata per mm<sup>2</sup> is >36 in the upper epidermal region while it is >63 in the lower epidermal surface. Guard cell size and size of the pore is almost identical in the upper and lower epidermis. Size of epidermal cells is almost equal in the upper and lower epidermis (Table 2).

*Palynological Studies:* The length of the pollen grain is 82µm and its width is >57µm. Pollen grain count indicates >107 pollen grains per mm<sup>2</sup>. A pollen stainability study clearly indicates that 82% of pollen grains are fertile (Table 2).

## PINK PEARL

*Morphological Studies:* Plants attain a height up to 47cm and on average produce four green leaves. Normally a plant produces more than one shoot. The maximum length of the leaf is >110cm and its width is approximately 4cm. In the blooming season the spike emerges out from the bulb directly. Average spike length is 47cm and its diameter is 2.52cm. The nature of the spike is fistular and its colour is green. Each spike produces two flowers at the top of the spike. The flowers face opposite to each other at 180° angles. Flower height is 16cm and its size is >17cm across. Each flower has six petals. The length of the petal is >10cm and its width is 7cm. The colours of the petal are very attractive. At the outer region of the petal is Red Group 52B Fan-1 while the middle portion of the petal is Red Group 52A Fan-1, and the throat region has an entirely different colour; i.e., Yellow-Green Group 158A Fan-4 and the colour of the filament is Yellow-White Group 158A Fan-4. The filament is long and its length is >9cm. Filaments have anther lobes at their tips. Anther lobes are dull yellow in colour. Filaments are very attractive as they display three colours; i.e., green, white and red. Colour of the basal region of the filament is Yellow-Green Group 144D Fan-3, while the middle portion of it is white and the terminal portion is red (Red Group 52B Fan-1).

The length of the style is >10cm and its colour is red (Red Group 52B, Fan-1.) (Table 1, Fig. 1).

Anatomical Studies: Approximately 25 stomata per mm<sup>2</sup> were observed in the upper surface of the leaf while the number of stomata increased almost two fold in the lower surface where >47 stomata per mm<sup>2</sup> were observed. Length and width of the guard cell and length & width of the pore were almost similar in the stomata present on the upper and lower surface of the epidermis. The slight variation in the size of the guard cell and pore was mainly due to its variation stages of the opening. The length of epidermal cells of the upper surface was 246µm and their width was 41µm, which was quite large in comparison to the lower epidermal cell sizes. This difference in the epidermal cell size was significant. This may be explained due to the fewer number of the epidermal cells present in the upper epidermis in comparison to huge numbers of epidermal cells present in the lower epidermis (Table 2).

Palynological Studies: The number of pollen grains present per mm<sup>2</sup> area was approximately 145, and their length was 100µm and width was 66µm. Pollen stainability studies clearly indicated that *Hippeastrum* cv. 'Pink Pearl' produced 80% fertile pollen grains (Table 2).

## FIRE FLY

Morphological Studies: Plants attains a height up to 45cm and produce more than one shoot. Plants have green foliage and more than three leaves. Length of the mature leaf is 44cm and its average width is 3cm. The spike directly emerges out from the bulb and attains a height of 44cm. Diameter of the spike is >2cm and its colour is green. The spike is fistular. The spike of 'Fire Fly' produces more than two flowers. Flower height is 12cm. Flower size is approximately 14cm across in north-south direction and on east-west direction it is approximately 13cm. The flower produces six petals. Length of the petal is >11cm and its width is 4cm. The style is well developed and its length is 9cm. The style has a trifid stigma on its tip and its colour is White Group 155D Fan-4. Colour of the petal is very attractive due to the presence of blending of three colours. At the apical region the colour of the petal is Red Group 55A Fan-1, middle region of the petal is White Group 155B Fan-4, and at the base (throat area) it is Yellow-Green Group 145B Fan-3. Colour of the filament is Yellow-White Group 158A Fan-4. Stamens are bent at the apical region towards the center of

the flower. Colour of the anther lobe is dull yellow. Filaments are very attractive due to the presence of three colours. The colour of basal portion of the filament is Yellow-Green Group 145B Fan-3. The middle portion of the filament is white and the terminal portion of it is light pink. The style is long and its colour is light pink. The colour of the stigma is dull white and its nature is trifid (Table 1, Fig. 1).

Anatomical Studies: Number of stomata in the upper epidermis is  $>18$  per  $\text{mm}^2$  while the lower epidermis has  $>19$  stomata per  $\text{mm}^2$  area. The size of guard cells and pores present on the upper epidermis are bigger in comparison to guard cells of lower epidermis (Table 2). The size of epidermal cell of the upper surface is  $335\mu\text{m}$  and width  $59.5\mu\text{m}$ , while the epidermal cell of the lower surface was comparatively smaller in size. The length of the lower epidermal cell is  $306\mu\text{m}$  and its width is  $42\mu\text{m}$  (Table 2).

Palynological Studies: Pollen grain size of the *Hippeastrum* cv. 'Fire Fly' was  $>77\mu\text{m}$  in length and its width was  $62\mu\text{m}$ . The number of pollen grains per  $\text{mm}^2$  was observed at  $>110$ . On the basis of pollen stainability studies *Hippeastrum* cv. 'Fire Fly' showed 86% pollen grain fertility (Table 2).

## BLEEDING HEART

Morphological Studies: Plants attain a height up to 65cm and produce two shoots. Mature plants have more than four leaves. Colour of the foliage of green. The length of the largest leaf is 55cm and its width is approximately 4cm. At blooming period the spike emerges out from the bulb. The height of the spike is 65cm and its diameter is 2.5cm. Colour of the flowering stalk is green and its nature is fistular. The spike bears more than two flowers at the tip. Flower height is  $>14\text{cm}$  and its size is 15.6cm across. Each flower has six petals. The length of the petal is 10cm and its width is  $>5\text{cm}$ . Petals have three distinct zones which are responsible for the beauty of the flower. The colour of the outer portion of the petal is Red Group 42A Fan-1, while the middle area of the flower is White Group 155D Fan-4, followed by the Green Group 142B Fan-3 colour which is very prominent at the throat region. Stamens are very prominent, introse and number six. Filaments are long and their length is 9.9cm. Filament colour is white. They are slightly bent inward at the tip just adjacent to the anther lobe. Colour of the anther lobe is light yellow (Yellow-White Group 158A Fan-4). Style length is  $>10\text{cm}$ . The colour of the stigma is White Group 155A Fan-4 (Table 1, Fig. 1).

Anatomical Studies: Stomata count per  $\text{mm}^2$  indicated that in the upper

surface 27 stomata were observed while the number of stomata per  $\text{mm}^2$  area increased by more than 2 fold in the lower epidermis where more than 58 stomata were recorded. Guard cell and pore size (length & width) were found increased in lower epidermis in comparison to upper epidermis. Epidermal cell size; i.e., length was observed at  $266\mu\text{m}$  in the upper epidermis while in the lower epidermis its size was found lesser; i.e.,  $255\mu\text{m}$ . Slight reduction in cell width was observed in the cells of lower epidermis but this decrease in length was found not to be significant (Table 2).

*Palyнологical Studies*: Pollen grain length was  $88\mu\text{m}$  and width was  $>72\mu\text{m}$ . More than 143 pollen grains per  $\text{mm}^2$  were observed. A pollen stainability study clearly indicated that *Hippeastrum* cv. 'Bleeding Heart' produced 84% fertile pollen grains (Table 2).

#### PRAKASH

*Morphological Studies*: Plants attain a height up to 51cm and produce two shoots. The mature plant produces five green leaves. The length of the leaf is approximately 59cm and its width is 5cm. The spike emerges from the bulb when the plant attains five leaf stage. Length of the spike is 51cm and its diameter is 2.12cm. The spike is fistular and its colour is green. The spike produces 2-3 flowers. Flower height is  $>13\text{cm}$  and its size is 15cm across (Table 1). A flower produces six petals. Colour of the petal near the tip region is Red-Purple Group 58A Fan-2 while the colour of the petal in the middle region is White Group 155B Fan-4. The basal region of the petal is Yellow-Green Group 144D Fan-3. The nature of the style is filamentous. Length of the style is  $>10\text{cm}$ . At the tip of style the trifid stigma is prominent. Colour of the stigma is White Group 155A Fan-4. Stamens are six in number and they are well developed. Stamens are slightly curved at the top region and bent toward the center of flower. Colour of the anther lobe is Yellow-White Group 158B Fan-4. Anther lobes are small in size. Colour of the anther lobe is Yellow-White Group 158B Fan-4. The filament is long in comparison to the anther lobe and its length is  $>9\text{cm}$  (Table 1, Fig. 1).

*Anatomical Studies*: Number of stomata per  $\text{mm}^2$  in the upper epidermis of leaf is  $>21$ , while its number is more in the lower epidermal cells where  $>35$  stomata are recorded per  $\text{mm}^2$ . Length and width of guard cells from the upper surface is  $60.2\mu\text{m}$  and  $14.5\mu\text{m}$  respectively, while comparatively smaller sizes of the guard cells are recorded in the lower epidermis where

guard cell length of 55µm and width 13.2µm occurs. Length and width of pore from the upper epidermis is measured at 55.3µm and 9.7µm respectively, in comparison to 46.7µm and 9.0µm of the lower epidermis. Length of the epidermal cells of the upper surface is 238.7µm and their width is 40.2µm. Cells of lower epidermal cells are comparatively smaller in size. The length & width of lower epidermal cells is 220µm and 52µm (Table 2). Palynological Studies: Pollen grain size in *Hippeastrum* cv. 'Prakash' was >85µm in length and its width was 66µm. Greater than 115 pollen grains per mm<sup>2</sup> were recorded. A pollen stainability study clearly indicated that *Hippeastrum* cv. 'Prakash' produced 90% fertile pollen grains (Table 2).

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**Figure 1.**

**TABLE 1. VEGETATIVE AND FLORAL CHARACTERS OF SIX CULTIVARS OF *HIPPEASTRUM***

Characters	Dutch Belle	Snow White	Pink Pearl	Fire Fly	Bleeding Heart	Prakash
<b>(A) Growth</b>						
Number of sprouts per plant	(1)-2-(3)	1-2	1-2	1-2	(1)-2-(3)	(1)-2-(3)
Plant height (cm) $\pm$ SE	50.00 $\pm$ 0.89	57.00 $\pm$ 1.72	47.00 $\pm$ 0.63	44.50 $\pm$ 1.49	65.00 $\pm$ 1.26	51.40 $\pm$ 0.75
Leaf number per plant	(4)-5-6-(7)	(3)-4-(5)	(3)-4-(5)	(2)-3-4-(5)	(3)-4-5-(6)	(4)-5-(6)
Leaf size (cm) $\pm$ SE Length	50.20 $\pm$ 1.77	35.00 $\pm$ 1.60	40.80 $\pm$ 1.79	44.20 $\pm$ 1.27	55.40 $\pm$ 1.68	58.60 $\pm$ 1.08
Width	5.60 $\pm$ 0.19	2.90 $\pm$ 0.10	3.90 $\pm$ 0.19	2.98 $\pm$ 0.15	3.90 $\pm$ 0.38	4.64 $\pm$ 0.12
<b>(B) Flower</b>						
Length of spike (cm) $\pm$ SE	48.40 $\pm$ 1.18	55.20 $\pm$ 0.33	59.70 $\pm$ 1.16	60.60 $\pm$ 1.39	61.82 $\pm$ 0.76	52.30 $\pm$ 0.93
Diameter of spike (cm) $\pm$ SE	2.62 $\pm$ 0.12	2.36 $\pm$ 0.12	2.28 $\pm$ 0.15	2.54 $\pm$ 0.18	2.20 $\pm$ 0.16	2.12 $\pm$ 0.21
Number of flowers per spike	(2)-3-4-(5)	(2)-3-(4)	2	2	2-3	(1)-2-3-(4)
Flower height (cm) $\pm$ SE	16.80 $\pm$ 0.22	15.20 $\pm$ 0.41	16.00 $\pm$ 0.63	12.60 $\pm$ 0.19	14.10 $\pm$ 0.32	13.50 $\pm$ 0.16
Flower size N-S (cm) $\pm$ SE	17.78 $\pm$ 0.20	10.98 $\pm$ 0.13	17.10 $\pm$ 0.39	13.86 $\pm$ 0.92	15.60 $\pm$ 0.38	15.62 $\pm$ 0.37
E-W	18.36 $\pm$ 0.36	10.82 $\pm$ 0.19	16.84 $\pm$ 0.50	12.92 $\pm$ 0.58	15.36 $\pm$ 0.54	15.24 $\pm$ 0.41
Number of petals	6	6	6	6	6	6
Size of petal (cm) $\pm$ SE Length	13.05 $\pm$ 0.34	10.10 $\pm$ 0.40	10.75 $\pm$ 0.34	11.08 $\pm$ 0.15	10.00 $\pm$ 0.28	11.13 $\pm$ 0.43
Width	8.43 $\pm$ 0.10	4.40 $\pm$ 0.23	7.21 $\pm$ 0.16	4.11 $\pm$ 0.11	5.31 $\pm$ 0.28	4.53 $\pm$ 0.39
Length of stigma (cm) $\pm$ SE	12.64 $\pm$ 0.24	9.76 $\pm$ 0.22	10.48 $\pm$ 0.17	9.16 $\pm$ 0.08	10.68 $\pm$ 0.13	10.30 $\pm$ 0.18
Length of stamen (cm) $\pm$ SE	11.78 $\pm$ 0.23	9.26 $\pm$ 0.22	9.34 $\pm$ 0.20	8.24 $\pm$ 0.07	9.96 $\pm$ 0.12	9.42 $\pm$ 0.19
<b>(C) Colour of flower</b>						
Colour of petal Outer	Red Group 52C Fan-1	Yellow Group 2D Fan-1	Red Group 52B Fan-1	Red Group 55A Fan-1	Red Group 42A Fan-1	Red-Purple Group 58A Fan-2
Middle	Red Group 48C Fan-1	White Group 155B Fan-4	Red Group 52A Fan-1	White Group 155B Fan-4	White Group 155D Fan-4	White Group 155B Fan-4
Throat	Yellow-Green Group 145B Fan-3	Yellow-Green Group 150B Fan-3	Yellow-Green Group 144D Fan-3	Yellow-Green Group 145B Fan-3	Green Group 142B Fan-3	Yellow-Green Group 144D Fan-3
Colour of stigma	White Group 155A Fan-4	White Group 155B Fan-4	White Group 155B Fan-4	White Group 155D Fan-4	White Group 155A Fan-4	White Group 155A Fan-4
Colour of stamen	Yellow-White Group 158A Fan-4	Yellow-White Group 158B Fan-4	Yellow-White Group 158A Fan-4	Yellow-White Group 158A Fan-4	Yellow-White Group 158A Fan-4	Yellow-White Group 158B Fan-4



**TABLE 2. Anatomical and Polynological characters of six cultivars of *Hippeastrum*.**

Characters	Dutch Belle	Snow White	Pink Pearl	Fire Fly	Bleeding Heart	Prakash
<b>(A) Upper Surface</b>						
Number of stomata (per mm <sup>2</sup> ) ± SE	29.40 ±1.57	36.60 ±2.87	24.60 ±1.32	18.60 ±1.32	27.00 ±1.16	21.60 ±1.25
Guard cell size (µm) ± SE Length	56.00 ±1.12	44.50 ±0.85	58.00 ±0.77	70.00 ±0.62	41.25 ±0.24	60.25 ±0.55
Guard cell size (µm) ± SE Width	13.25 ±0.71	13.50 ±0.38	12.25 ±0.23	21.75 ±0.17	14.00 ±0.14	14.50 ±0.31
Pore size (µm) ± SE Length	48.00 ±0.77	29.00 ±0.80	51.25 ±0.53	57.25 ±1.04	35.25 ±0.28	55.25 ±0.55
Pore size (µm) ± SE Width	11.50 ±0.52	6.75 ±0.50	8.25 ±0.50	11.00 ±0.88	11.50 ±0.22	9.75 ±0.74
Epidermal cell size (µm) ± SE Length	261.25 ±12.80	195.00 ±12.52	246.25 ±8.84	335.00 ±8.09	266.50 ±6.12	238.75 ±12.17
Epidermal cell size (µm) ± SE Width	40.00 ±2.42	44.75 ±1.71	41.25 ±1.23	59.50 ±1.53	45.25 ±1.28	40.25 ±0.96
<b>(B) Lower Surface</b>						
Number of stomata (per mm <sup>2</sup> ) ± SE	41.40 ±1.32	63.60 ±1.73	47.40 ±3.33	19.20 ±1.13	58.20 ±1.34	35.40 ±2.15
Guard cell size (µm) ± SE Length	56.50 ±0.72	46.50 ±0.72	51.75 ±1.41	65.00 ±1.50	52.50 ±1.38	55.25 ±1.71
Guard cell size (µm) ± SE Width	16.50 ±0.52	11.75 ±0.79	13.75 ±0.39	17.25 ±0.65	16.50 ±1.46	13.25 ±0.50
Pore size (µm) ± SE Length	47.75 ±0.55	31.00 ±1.70	45.00 ±1.32	52.75 ±2.24	44.75 ±1.56	46.75 ±1.45
Pore size (µm) ± SE Width	14.00 ±0.52	6.50 ±0.72	8.50 ±0.94	15.25 ±1.38	13.75 ±1.24	9.00 ±0.52
Epidermal cell size (µm) ± SE Length	222.50 ±8.05	190.00 ±8.97	175.00 ±6.57	306.25 ±7.87	255.00 ±8.24	220.50 ±4.12
Epidermal cell size (µm) ± SE Width	43.50 ±2.15	35.00 ±1.36	34.75 ±1.34	42.00 ±1.57	43.00 ±1.38	52.00 ±1.96
<b>(C) Pollen</b>						
Number of pollen (per mm <sup>2</sup> ) ± SE	168.60 ±6.81	107.40 ±6.14	145.20 ±7.85	110.40 ±4.17	143.40 ±6.59	115.80 ±7.87
Pollen size (µm) ± SE Length	96.25 ±1.62	81.75 ±2.29	100.00 ±2.29	77.75 ±1.63	88.25 ±4.43	85.75 ±3.35
Pollen size (µm) ± SE Width	67.25 ±1.08	57.75 ±2.04	66.00 ±0.80	62.00 ±1.16	72.7 ±1.38	66.00 ±1.12

# TUBEROSE CULTIVATION, DISEASE MANAGEMENT AND ITS ECONOMIC IMPORTANCE

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## INTRODUCTION

The tuberose (*Polyanthes tuberosa* L., Rajanigandha) is a bulbous plant belonging to the family Amaryllidaceae. The Sanskrit name for tuberose, Rajnigandha, means “fragrance of the night”. Botanically, *Polyanthus tuberosa* was already domesticated in Mexico at the time of the Spanish conquest and no forms of it growing in the wild have ever been discovered or seen. In India it is grown extensively in the eastern part of the country but also in northern plains and parts of south for cut flower and bulb production. A very good quality of essential oil is obtained from flowers which is widely used in the perfume and cosmetic industries. If grown only for flower production, the climate must be warm and humid. Profuse flowering can be obtained throughout the year where the climate is mild.

## VARIETIES OF TUBEROSE

The main varieties are ‘single’ with one row of corolla segments and ‘semi double’ with two to three rows of segments. The commercial varieties of single tuberose are Calcutta Single, Calcutta Double, Hyderabad Single, Hyderabad Double, Phule Rajni, Mexican Single, and Sikkim Selection, which are commercially grown in different states. Four new cultivars of tuberose have been developed at the Indian Institute of Horticultural Research, Bangalore, viz. Prajwal, Suvashini, Vaibhav and Shringar. Two gamma-ray-induced mutants of tuberose were released from National Botanical Research Institute, Lucknow in the year 1974. The details of the important cultivars and their characters are given in Table 1.

## PROPAGATION

Plant propagation is through seeds and bulbs. Vegetative propagation is

**TABLE 1. Vegetative and Floral Characters and Use of Tuberose Varieties**

Name of Variety	Bud colour	Foliage & Flower colour; Spike, Seed setting & Concrete characteristics	Use of flowers
<b>SINGLES</b>			
Calcutta Single	White tinged with pink red	Foliage green White, Spike grows straight	1. Extensively used as cut flower and loose flower 2. Extraction of essential oil
Mexican Single	White	Foliage green Greenish white, Highest concrete recovery 0.135%, Bears seed	1. Extensively used as cut flower and loose flower 2. Extraction of essential oil
Shringar (Mexican single X Pearl double) IIHR, Bangalore 1994	White	Foliage green Pinkish white, 36% higher flower yield Concrete recovery 0.133% Produces seeds under favourable conditions	1. Extensively used as cut flower and loose flower 2. Ideal for pot culture 3. Suitable for landscaping
Prajwal IIHR, Bangalore 2001	White	Foliage green Flower colour pinkish Borne on a tall and stiff spike, flowers are large in size and have heavy weight	1. Extensively used as cut flower and loose flower 2. Extensively used in perfume industry
Arka Nirantara IIHR, Bangalore 2010	White	Foliage green Pinkish Early blooming, higher spike yield, profuse blooming	1. Ideal for loose flower 2. Used as cut flower and loose flower
Phule Rajni (Local single X Shringar) MPKV, Rahauri 2008	White	Foliage green Greenish white Spike straight with 52 florets (Range 46-58) Rachis length is >50% of the spike length	1. Extensively used as cut flower and loose flower
Rajat Rekha (Gamma ray induced mutant) NBRI, Lucknow 1974	White	Foliage variegated White flowers Spike straight Silvery white streaks are prominent along the margin of the blade	1. Ideal as a potted plant and can be used for decoration of lawn 2. Used as cut flower and loose flower
<b>DOUBLES</b>			
Pearl Double	Tinged with pinkish red	Foliage green Dull white Incomplete opening of the flowers Blooms are sterile No seed formation	1. Used as a cut flowers
Suvashini (Mexican single X Pearl double) IIHR, Bangalore 1994	Pinkish white	Foliage green Flowers white, flowers are big and bold, all florets of the spike bloom	1. Used as a cut flowers 2. Spikes are best suited for cut flower
Vaibhav IIHR, Bangalore 2002	Greenish white	Foliage green Flower white Plant attains medium height	1. Best suited for cut flower
Calcutta Double	Tinged with pinkish red	Foliage green Flower colour is white tinged with pink red	1. Used as a cut flower
Swarn Rekha (Gamma ray induced mutant) NBRI, Lucknow 1974	Creamish white	Variegated foliage White flower double Leaves have golden yellow streak along the margin	1. Ideal as a potted plant and can be used for decoration of lawn 2. Used as cut flower and loose flower

preferred because the resultant plants produce better flowers within a short period of planting. Bulbs 2-3cm in diameter are suitable for propagation. Planting of freshly harvested bulbs produces smaller number of flowers and therefore bulbs should be stored for a month or more before planting to ensure better production of flowers. Planting larger-sized bulbs gives early flowering and higher yields. The bulbs should be planted 4-5cm deep in beds, and soil moisture should be maintained till onset of the monsoon. Old dead roots at the base of the bulb should be removed. The pips when planted 12-15cm apart in drills and properly tended will yield blooming bulbs for the following year.

### CULTIVATION

High light intensity is required for better bulb and flower production. For higher bulb production, tuberose must be grown under full sun. It has been reported that exposure to a day length of approximately 16 hours promotes the vegetative growth of plant and enhances the emergence of spikes by ten days. Better bulb growth has been observed in large pots (25 to 30cm). Since plants grown in pots tend to be warmer than those grown in the ground, they often bloom a few weeks earlier.

Tuberose is a tropical plant and grows well round the year under moderate climatic conditions like in Bangalore. However, it is well adapted to our sub-tropical conditions (north Indian plains) and grows profusely from April to November. It becomes dormant with the advent of winter season, as evident by the cessation of vegetative growth. High 40° C as well low 10° C temperatures reduce the length of spike, weight and quality of flowers.

Soil and Bed preparation: The plant can be successfully grown on a wide range of soils including those inflicted with mild acidity or alkalinity. It is very sensitive to water-logging; however, sandy and sandy loam soils in pH range of 6.5 to 7.5 with proper aeration and drainage are considered best for tuberose cultivation.

Planting Season and Spacing: Tuberose can be commercially grown throughout the year but highest yield is obtained from February through October. However, best time for planting is from the second to the last week of March, whereas April-May is the appropriate time for hilly areas.

Nutrition: The nutritional requirement for tuberose crop varies with several factors like climatic conditions, types of soil, cultivar planted and spacing. It was found that nitrogen is more vital element than phosphorus

or potassium and influences yield and quality of flowers and bulb production in tuberose. During preparation of the soil, a basal application of farm yard manure (FYM) at the rate of 12 to 15 tones per hectare should be done to ensure better growth and flowering. Application of FYM in tuberose ensures a good quality of major and micronutrients. A fertilizers mixture containing 6gm of urea, 16gm each of single super phosphate (SSP) and potash per square meter gives satisfactory growth and flowering. The above mixture should be applied in two equal doses – the first dose should be applied before plantation, and the second one at four weeks after sprouting of the bulbs. Foliar feeding of K and N produces more flowers with better quality. Most of the nutrients become available to the plants in the pH range of 6.5 to 7.5 with good aeration.

Land is prepared well by plowing two or three times. FYM @ 30t/ha is mixed well with the soil. Bulbs preferably those of size 2-5cm or above are planted at a depth of 7-10cm, with a spacing of 20-25cm. A fertilizer dosage of 100:50:50kg/ha N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O is recommended. Of these, half N, complete P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O are applied at the time of planting. Remaining N is applied when the flower spikes start to appear. A heavy irrigation once in 5-10 days is necessary depending upon the weather conditions. The peak flowering is between June and October.

Watering: Soil moisture is an important factor affecting growth, flowering and bulb yield of tuberose. Fields should be irrigated before planting of bulbs and further irrigation should be avoided until the bulbs sprout. The crop should be irrigated at weekly intervals in the absence of rainfall. Mulching reduces the water requirement by minimizing the evaporation losses. However, irrigation should be avoided at the maturity stage of bulbs during December-January. Mulching is primarily carried out for conserving soil moisture and checking weeds in the field. *Gliricidia sepium* leaves are the most suitable mulch for tuberose cultivation. About 5kg of green leaves of *Gliricidia* are sufficient for a 1m x 1m plot to harvest a bumper yield with quality of flowers and spikes. Paddy straw can also be used for mulching in tuberose to conserve soil moisture and to reduce weed population. Basically, bulbs need warmth, sunshine, well-drained soil, even moisture, and at least a month and a half of good growing.

Weeding: Weeding is carried out after a fortnight, especially during the initial stage of bulb sprouting and growth of plants. Hand weeding is eco-friendly but expensive.

## INSECT, PEST AND DISEASE MANAGEMENT

In the plains of UP, the incidence of disease in tuberose crop is not severe; however, incidence of various types of diseases of tuberose have been reported from different states of our country. Tuberose crop is attacked by various types of bacterial, fungal and viral diseases. Slugs and grasshoppers, foliar nematode, and root knot nematode also attack tuberose crop and causes severe damage (Banerji and Dwivedi, 2009). Pests which are responsible for creating damage to the crop include aphids, thrips, red spider mites, weevils, slugs and grasshoppers.

**Bacterial Disease:** Flower Bud Rot is a bacterial disease caused by *Erwinia* species. The disease appears mainly in young flower buds and results in dry rotting with brown-scorched necrotic discoloration of peduncles. In the advanced stage, buds become shriveled and dry. The disease is mainly spread by thrips. Destroy or burn the infected plant debris to check further infection and adopt remedial measures to control the thrips.

Control: 1) Spraying of Rogor 0.1% twice at a week; and 2) Destroy or burn the infected plant debris to check any further infection.

**Viral Disease:** A potyvirus of *Polyanthes tuberosa* has been reported from China, New Zealand and Taiwan. Tuberose leaves exhibit mottling symptoms. The causal organism is mild mosaic virus (TuMMV). It has also been reported from Himachal Pradesh.

Control: Use of disease free plant material for cultivation. The infected plant should be rooted out and burned immediately to check further infection.

**Slugs and Grasshoppers:** Slugs and grasshoppers attack the tuberose plant and they feed on the leaves and causes damage to the plant.

Control: Spray of 0.1% Malathion and carbaryl are effective against these pests.

**Foliar Nematode:** Damage caused by nematodes in commercial cultivation of tuberose is severe in West Bengal. The disease was reported from Ranaghat area of Nadia district of West Bengal. The nematode has recently spread to Orissa presumably through bulbs. The primary causal organism is *Aphelenchoides besseyi*, and it is now today's major limiting factor for cultivation of tuberose in Ranaghat, Haringhata and Banskera area of West Bengal. Calcutta single cultivar of tuberose is more vulnerable to *A. besseyi* than the Calcutta double.

The main symptom appears on spikes, where malformed flowers can

be easily detectable in a population. Spikes look initially rough, crinkled, stunted and finally distorted. In severe cases spikes become rotten and brittle. The number of flowers in a spike is significantly reduced. During the rainy season the infection is more severe, generally from June to September. Infected bulbs harbor nematodes in the scaly leaves outside the bulbs. Nematodes can also survive in the dry scaly leaves, stem and flowers for more than 25 months.

Control: 1) Pre-soaking of bulbs in plain water or in Neem seed kernel extract (SSKE4%) for overnight followed by dipping in Monocrotophos 36SL at 5000ppm for 4-6 hours; 2) Three to four sprayings with Monocrotophos 36SL at 5000ppm for 15-20 day intervals are required after sprouting; 3) Field sanitation is a must for reducing the infection; and 4) Infected plant parts should be burned.

Root Knot Nematode: The causal organism is *Meloidogyne incognita*. The infected plants show symptoms of dwarfing, yellowing and withering. There are many galls on the diseased roots. Severely infected plants have a thin floral axis and few flowers, while the most severely infected plants cannot survive.

Control: 1) Pre-soaking of bulbs in Neem seed kernel extract (SSKE4%) overnight followed by dipping in Monocrotophos 36SL at 5000ppm for 4-6 hours; 2) Field sanitation is a must for reducing the infection; and 3) Infected plant parts should be burned.

Thrips: Thrips which damage and cause distortion of the spikes are the major pests. Thrips feed on leaves, flower stalks and flowers. They suck sap from these parts and ultimately damage the whole plant. Sometimes they are associated with a contagious disease known as bunchy top where the inflorescence is completely malformed.

Control: 1) Thrip attacks can be managed by spraying the plant with 0.1% Rogor twice at 10 days intervals; 2) Spraying Dimethoate or Oxydemetonmethyl 0.05% or Imidaclofrid 0.01% or Cartap Hydrochloride 0.075% at 15 days intervals control thrips; and 3) Malathion and Carbaryl are also very effective against these pests.

Aphids: The disease is caused by *Aphid spiraecola*. It is a small green-coloured aphid which sucks the sap of the plant. The aphid attacks buds and growing spikes. Infected spikes are damaged due to falling of the buds and flowers from the spike. The affected spikes wither and droop.

Control: 1) Spraying of Pongamia or Neem oil at early infection

levels prevents pest multiplication; and 2) Spraying Dimethoat or Oxydemeton Methyl 0.05% or Imidacloprid 0.01% or Acephate 0.075% at 15 day intervals controls aphids.

Weevils: The pest is known as *Mylloceris* spp. Adults are ash coloured and feed on leaves during night hours, and it is difficult to locate them. The symptoms appear on leaves and are clearly visible due to cuts in margin sides.

Control: 1) Fortnightly spray of Malathion 0.1% or Carbaryl 0.2% taken up during evening protects the foliage from weevil damage; and 2) Drenching beds with Chloropyrifos or Malathion 0.1% reduces grub populations.

Penta Tomid Bug: The pest belongs to *Nezara viridula* and causes damage in flower production of tuberose. In the first stage eggs are laid in groups on leaf surfaces. Nymphs are green coloured. Adults suck the sap from the basal portion of growing buds and flowers. In severe infections an affected bud withers and drops off and causes great loss in flower production.

Control: 1) Hand picking of adults as far as possible and destruction of egg masses checks the damage; and 2) Spraying Malathion 0.1% or Endosulphon 0.07% controls the bug.

Red Spider Mites: First symptoms of spider mite attack on tuberose appear on foliage in the form of yellow stripes and streaks. Mites suck sap from the foliage. The leaf becomes yellow, silvery and in later stages bronze, causing distortion of foliage.

Control: 1) Spraying with Kelthane (2ml/l) has been found to be very effective in controlling the mites.

## TUBER COLLECTION AND STORAGE

Harvesting tuberose bulbs at the proper stage of maturity is important. Bulbs reach maturity when the flowering is over and plant growth ceases. At this stage, old leaves become dry, plant growth almost stops, and bulbs become dried. About 100 quintal of bulbs can be harvested from one hectare of land.

Commercial Cultivation and Techno-economics: Commercially, if flowers are field grown, the bulbs are dug up in November and stored over winter in airy, dry places. In the spring, they are separated and replanted in April. Techno-economics of tuberose commercial cultivation as worked out at National Botanical Research Institute, Lucknow indicates that net profit



of Rs.85,000/- (Eighty five thousand rupees; 1US\$ = Rs.49/- as of October, 2011) can be earned from one acre of tuberose cultivation.

Uses: It is a popular cut flower not only for use in arrangements but also for individual florets that can provide fragrance to buckets and boutonnières. It has great economic potential in the cut flower market and in the essential oil industry. The flowers are used to make garlands and small bouquets which are used during spiritual retreats, birthday celebrations, marriage and religious ceremonies, wedding anniversaries and even as wreaths for departed souls.

### SUMMARY

Tuberose, a very popular cut flower crop in India, is grown mainly in the eastern part of the country, i.e., West Bengal, and also in the northern plains and parts of South India. It is commercially cultivated for cut and loose flower trade and also for the extraction of its highly valued, natural flower oil. Tuberose bulbs are also sold. Tuberose flowers can be grown with success under wide environmental conditions ranging from tropical to sub-tropical and temperate climates. Both single and double flower varieties are equally popular. It grows in elongated spikes that produce clusters of white flowers that are 5-6cm long and have a characteristic bending. The flower spikes grow up to 60cm in height. Tuberose flowers bloom in acropetal succession (from the bottom toward the top of the spike). The flowers remain fresh for a long time and are suitable for long distance transportation. Flower yield varies with varieties, plant density, bulb size at planting time, and crop management. The flowers of this plant bloom in the night. The sweet smell is also there in the morning. It is a unique flower - possibly the one which is used in every sphere of the Indian-Hindu life. The morphological characters of tuberose cultivars, viz. Calcutta Single, Calcutta Double, Hyderabad Single, Hyderabad Double, Phule Rajni, Mexican Single, Sikkim Selection, Prajwal, Suvashini, Vaibhav, Arka Nirantara and Shringar, Swarn Rekha, Rajat Rekha are documented, which are commercially grown in Assam, Maharashtra, Gujarat, Haryana, Karnataka, Andhra Pradesh, Tamil Nadu, Uttar Pradesh, Uttarakhand, West Bengal and Orissa.

In the present paper, commercial cultivation of tuberose, soil and bed preparation, propagation, planting season, intercultural practices, insects, pests, disease management, techno-economics, uses along with

tuber collection and storage of tuberose have been discussed for farmers, nurserymen and hobby oriented growers.

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## MUSINGS IN INTERGENERIC HYBRIDS – 1. BACKCROSSES OF *xHOWARDARA* LEHMILLER (AMARYLLIDACEAE)

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Lehmiller (2010) introduced a new intergeneric hybrid, *xHowardara*, which was a trigeneric hybrid between *Hippeastrum*, *Sprekelia*, and *Zephyranthes*. The cross involved a *Hippeastrum* hybrid (*H.* ‘Hercules’), two different species of *Sprekelia* (*S. formosissima* and *S. howardii*), and *Zephyranthes traubii*, the latter bulb being the final seed parent. This complex cross yielded 3 bulbs, two of which bloomed in 2010, and all bulbs bloomed in 2011, producing as many as 4 scapes per bulb. All bulbs bore uni-flowered scapes bearing attractive brilliant-red flowers; the floral color was remarkably uniform and unexpected since the final seed parent for the hybrid was *Z. traubii*, a white rainlily.

All attempts at using these *xHowardara* bulbs as seed parents in self-crosses, backcrosses and outcrosses were unsuccessful in 2010-2011. However, on two occasions, two different *xHowardara* bulbs were employed as pollen-donors in backcrosses with *Zephyranthes traubii* and yielded viable seeds. The parentage of these seeds was thus:

Backcross = *Z. traubii* x *xHowardara*

The two pollen-donor bulbs were the two blooming bulbs depicted in Fig. 6 of the original article (Lehmiller, 2010), with the flower on the left designated as “L” and the one on the right as “R”. A total of 4 bulbs resulted from Backcross-L and 5 bulbs from Backcross-R. The seeds were obtained in October 2010, and in early November 2011, just 13 months from seed, one bulb of Backcross-L (Fig. 1, 2) and two bulbs of Backcross-R (Fig. 3) bloomed.

The backcross flowers exhibit variability in color from dark red to pink, but all 3 flowers resemble *Zephyranthes* as would be anticipated from the large contribution of *Z. traubii* to the gene pool. All 3 flowers possess reddish scapes and spathe, with the scapes from Backcross-R being a striking-dark rust-reddish color. Interestingly, in the bud stage the style

(with stigma) protrudes beyond the bud tip approximately 8-10mm in all 3 flowers, similar to *xHowardara*.

All 3 initial flowers were self-pollinated to investigate seed production; only the pink flower in Fig. 3 yielded a few seeds. Backcrossing the pollen from the red flower in Fig. 3 onto *Z. traubii* was unsuccessful.

In late November 2011, an additional bulb of Backcross-R flowered (Fig. 4), this time the flower displaying a rose color, with a floral morphology similar to its siblings.

### **All photographs by the author**

#### **REFERENCE**

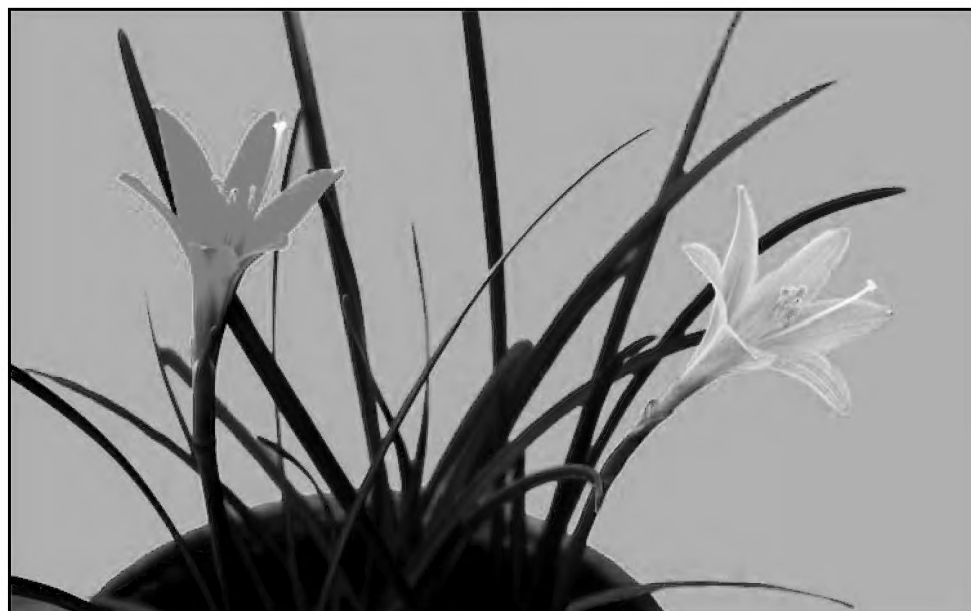
Lehmiller, D.J. 2010. *xHowardara*, a new trigeneric hybrid (Amaryllidaceae). *Herbertia* 64:125-135.



**Fig. 1.** *xHowardara* Backcross-L in flower; November 2, 2011.



**Fig. 2.** Close-up photo of *xHowardara* Backcross-L flower, November 2, 2011.



**Fig. 3.** *xHowardara* Backcross-R flowers, November 2, 2011.



**Fig. 4.** *xHowardara* Backcross-R flower; November 29, 2011.